Monitoring Future Economic Growth in Canadian Provinces with New Leading Economic Indexes

by

Jenness Cawthray, Carl Gaudreault and Robert Lamy*

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* This paper reflects the views of the authors and no responsibility for them should be attributed to the Department of Finance. For information, contact Robert Lamy: e-mail: lamy.robert@fin.gc.ca; Tel: 613 992-9013, Fax: 613 992-5773.

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Abstract

This paper proposes new leading economic indexes for Canadian provinces, based on the NBER methodology, to monitor future short-term business cycle developments. The empirical evaluation of the performance of the NBER leading economic indexes in signaling cyclical turning points and forecasting growth in provincial economic activity showed that they have useful properties. First, for all provinces, the cyclical turning points in the leading economic index lead the cyclical turning points in the coincident economic index. On average, the lead is 2.8 quarters (at cyclical peaks) and 0.2 quarters at cyclical troughs. Second, for all provinces, except Newfoundland and Prince Edward Island, the leading economic index signaled all recessions in the last two decades. An important weakness, however, is the large number of false signals – three on average in the last twenty years. Third, for all provinces, out-of-sample simulations from first quarter 1992 trough to fourth quarter 2000 showed that a leading indicator model, with growth in the leading economic index lagged one-quarter as the exogenous variable, performs significantly better in forecasting growth in the coincident economic index than ARIMA models.

Résumé

Ce papier présente de nouveaux indices économiques avancés pour les provinces canadiennes, construits avec la méthodologie du NBER, afin de suivre l'évolution future à court terme des cycles économiques provinciaux. L'évaluation empirique de la performance des indices économiques avancés en ce qui a trait au signalement des points de retournement cyclique et à la prévision de la croissance économique provinciale montre qu'ils ont des propriétés fiables. Premièrement, pour toutes les provinces, les points de retournement cyclique des indices économiques avancés devancent ceux des indices économiques coïncidents. En moyenne, l'avance est de 2,8 trimestres aux sommets cycliques et de 0,2 trimestres aux creux cycliques. Deuxièmement, pour toutes les provinces à l'exception de Terre-Neuve et de l'Île-du-Prince-Édouard, les indices économiques avancés ont annoncé toutes les récessions dans les deux dernières décennies. Toutefois, une faiblesse importante est le nombre élevé de faux signaux – trois en moyenne au cours des vingt dernières années. Troisièmement, pour toutes les provinces, les simulations hors échantillon du premier trimestre 1992 jusqu'au quatrième trimestre 2000 montrent qu'un modèle indicateur, avec la croissance de l'indice économique avancé retardé d'un trimestre comme variable explicative, fonctionne significativement mieux pour prévoir la croissance de l'indice économique coïncident qu'un modèle ARIMA.

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1. INTRODUCTION

Early detection of business cycle turning points has been always a major concern of policymakers, business and investors, notably today because of the uncertainty with regard to the state of the U.S. economy. Economists throughout the world have built leading economic indexes to help warn in advance of cyclical changes in the economy. But their development over the last forty years has focused mostly on national indexes.

Cyclical indicators for sub-national economies have gained in popularity since the late 1980s with the growing interest in regional business cycles. Phillips (1988) was the first to introduce coincident and leading indexes of economic activity for the state of Texas. Since, many economists have proposed regional cyclical indexes. One of them is Crone (1994), which used Stock and Watson methodology to construct coincident and leading indexes for the states of Pennsylvania and New Jersey. More recently, Lamy and Sabourin (2000) introduced coincident economic indexes for Canadian provinces.

This paper extends the work of Lamy and Sabourin by proposing a leading economic index for each Canadian province. The paper is organized as follows. Section 2 presents the reference cycle we intend to anticipate for each province and discusses how we identified their respective chronology. Section 3 describes the construction of the leading economic indexes, built on the basis of traditional NBER methodology. Section 4 evaluates the performance of each provincial leading economic index with respect to signaling in advance cyclical turning points and forecasting growth in economic activity. The last section summarizes the main findings of the paper.

2. BUSINESS CYCLE CHRONOLOGY

A leading economic index is always built around a reference series. For countries, such as Canada, the reference series is a high frequency estimate of real GDP. But that economic variable we intend to anticipate for Canadian provinces is only available annually from Statistics Canada.

Recently, Lamy and Sabourin (2000) introduced coincident economic indexes for all provinces. The indexes, which are synthetic measures of overall economic performance, are available quarterly from the beginning of 1979. We propose to use them as the reference series for the provinces.[1]

This section presents the states of the reference cycle for each province obtained by applying Markov-switching models developed by Hamilton (1989) to the coincident

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[1] The coincident indexes were constructed with the NBER methodology. They closely coincide with real GDP growth for most provinces. On a quarterly basis, the coincident indexes for Québec and Ontario explain near 60 per cent of the variance in their respective real GDP growth. On annual basis, the coincident indexes for Québec, Ontario, Alberta and British Columbia -- four provinces representing 90 per cent of Canadian real GDP -- predict about 80 per cent and more of the variance of their respective real GDP growth

economic indexes. We will begin with a brief description of the model and the estimation method.

2.1 The model

Markov-switching models involve modelling a time series non-linearly. Intuitively, the non-linearity in the data can be interpreted by thinking that the time series displays high- and low-growth rate states.

In Markov-switching models, it is assumed that a time series x_t can be expressed by the following general stochastic process:

$$x_t = u(S_t) + \sum_{i=1}^{n} \phi_i (S_t)(x_{t-i} - u(S_{t-i})) + \sigma(S_t) v_t \qquad v_t \sim N(0,1) \qquad [1]$$

The discrete variable S_t represents the state at time t. This means that, if x_t is a measure of overall economic activity of a province (ex: growth rate of the coincident index), then each of the various states has a different mean growth rate. The states are not observed and must therefore be inferred based on previous observations of the series (inferred smoothed probabilities for each state). $\phi_i(S_t)$ are the coefficients associated with the lags in the variable x_t and $\sigma(S_t)$ is the variance, both depend on the state at time t.

A simplified version of this model involves setting the number of states at two, the AR coefficients and the variance constant from one state to another, and the transition probabilities constant on the entire sample.[2] This gives:

$$x_t = u(S_t) + \sum_{i=1}^{n} \phi_i (x_{t-i} - u(S_{t-i})) + \sigma v_t \qquad v_t \sim N(0,1) \qquad [2]$$

where

$u(S_t) = \alpha_0$ if $S_t = 0$, [for example: low-growth state (recession)]

$u(S_t) = \alpha_0 + \alpha_1$ if $S_t = 1$, [for example: high-growth state (expansion)]

are the mean growth rates of each of the two states. The conditional transition probabilities from one state to another are:

$P(S_t = 0 \mid S_{t-1} = 0) = p$,	probability of remaining in recession
$P(S_t = 1 \mid S_{t-1} = 0) = 1 - p$,	probability of switching from recession to expansion
$P(S_t = 1 \mid S_{t-1} = 1) = q$,	probability of remaining in expansion
$P(S_t = 0 \mid S_{t-1} = 1) = 1 - q$,	probability of switching from expansion to recession.

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[2] This is the base model estimated by Hamilton (1989) and Bodman and Crosby (2000). Given the aim of the exercise is mainly concerned with the switching mean, this model is reasonable.

Hamilton (1989) uses this structure and applies an iterative filter over the sample, producing the likelihood function, which depends on both the number of possible patterns of state shifts in the sample and the number of possible parameter values for the density functions generating the data for a number of states equal to two. The parameters that we are trying to estimate are the means of the two states, the four autoregressive coefficients, the variance, and the transition probabilities p et q. Numeric optimisation provides estimated parameters that maximize the likelihood function of the sample.[3]

Using the estimated transition probabilities, we can calculate the estimated mean duration in quarters of the two states. The estimated mean duration of the recession and expansion states are respectively calculated as $((1 - p)^{-1})$ and $((1 - q)^{-1})$. To identify the chronologies of the provincial business cycles, we use the inferred smoothed probabilities obtained by estimating the Markov-switching models. The process is simple: a quarter is considered to be in recession when the inferred probability $S_t = 0$ is greater than 50 per cent. And a period of recession must last at least two consecutive quarters.

2.2 Business cycle chronology by province

As mentioned earlier, a Markov-switching model is estimated for each provincial coincident economic index over the 1980s and 1990s. All estimations include four lags in the AR process, $n = 4$ in equation 2.

We begin by applying the Markov-switching model to two Canadian time series to see if it would provide reliable chronology of the business cycle. The first time series is real GDP at market prices. The second time series is a weighted average of the provincial coincident indexes.

Table 1 (next page) displays the results for these two time series. The top part gives the results of the estimates of the Markov-switching models applied to the coincident index and real GDP. The bottom part gives the business cycle chronologies based on the Markov-switching models for the coincident index and real GDP and from other sources.

As for Cross (1996) and Bodman and Crosby (2000), the Markov-switching models applied to the coincident index and real GDP identifies two recessions in the past two decades.[4] For the 1981-1982 recession, the chronology obtained with Markov-switching models applied to the coincident index and real GDP is the same as reported in Cross (1996). The cyclical downturn begins in the third quarter of 1981 and ends in fourth quarter of 1982. The next recession identified by the coincident index begins a quarter later but ends in the same quarter as that identified with real GDP and by Cross (1996). See the appendix A (page 39) for the graphs of the inferred probabilities to be in a recession for Canada and the provinces.

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[3] This numeric optimisation process is very complex. Hamilton (1989) provides complete technical explanations for this process.

[4] Given that we included four lags in the models, the inferred smoothed probabilities, used to date the business cycles, do not begin until the second quarter of 1980.

Table 1
Business Cycle Chronology for Canada: Summary Results

A. Markov-switching models results

Variable	State	Mean growth rate	Transition probabilities (p and q)	Expected duration of each state
Coincident index				
	Expansion	0.84	0.96	24.6
	Recession	-1.15	0.73	3.6
Real GDP				
	Expansion	0.95	0.95	18.6
	Recession	-0.74	0.80	5.0

B. Business cycle chronologies: 1980 - 2000

	Recession	Expansion	Recession	Expansion
Markov-switching models				
Coincident index	81:Q3 - 82:Q4	83:Q1 – 90:Q2	90:Q3 - 91:Q1	91:Q2 –
Real GDP	81:Q3 - 82:Q4	83:Q1 – 90:Q1	90:Q2 - 91:Q1	91:Q2 –
Cross (1996)	81:Q3 - 82:Q4	83:Q1 – 90:Q1	90:Q2 - 91:Q1	91:Q2 –
Bodman and Crosby (2000)	81:Q1 - 82:Q3	82:Q4 – 89:Q3	89:Q4 - 90Q:4	91:Q1 –

In conclusion, the coincident index, which is a weighed average of the provincial coincident indexes,[5] provides a business cycle chronology of the Canadian economy closely similar that of the real GDP and the one found by Cross (1996). Thus, we assume that the provincial coincident indexes are the right measure of provincial economic activity.

Table 2 (next page) gives the business cycle chronologies for all Canadian provinces. The first column lists them with subsequent columns identifying the mean growth rates for the two states, the probability of remaining in a particular state, the average duration in quarters of the two states and the business cycles chronologies.

[5] Lamy and Sabourin (2000) showed that the weighted average of the growth in the provincial coincident indexes is highly correlated with Canada's real GDP growth. The correlation coefficient between the two series is slightly above 0.80 on a quarterly basis and close to one on an annual basis.

Table 2
Business Cycle Chronology for Canadian Provinces: Summary Results

Province	State	Mean growth rate	Transition probabilities (p and q)	Expected duration of each state	Business cycle chronology	
					Recession	Expansion
Nfld	*Expansion*	0.55	0.93	15.4	80:Q2-80:Q3	80:Q4-81:Q1
	Recession	-0.95	0.53	2.1	81:Q2-81:Q3	81:Q4-91:Q4
					92:Q1-92:Q2	92:Q3-
PEI	*Expansion*	0.53	0.91	10.6	81:Q3-82:Q1	82:Q2-83:Q4
	Recession	-1.41	0.49	2.0	84:Q1-84:Q2	84:Q3-89:Q1
					89:Q2-89:Q3	89:Q3-90:Q2
					90:Q3-91:Q1	91:Q2-
Nova Scotia	*Expansion*	0.76	0.97	37.7	80:Q2-80:Q3	80:Q4-
	Recession	-1.52	0.39	1.6		
NB	*Expansion*	0.63	0.93	14.5	81:Q3-81:Q4	82:Q1-90:Q2
	Recession	-2.36	0.19	1.2	90:Q3-91:Q1	91:Q2-
Québec	*Expansion*	0.65	0.96	25.3	81:Q4-82:Q3	82:Q4-90:Q2
	Recession	-1.49	0.66	2.9	90:Q3-91:Q1	91:Q2-
Ontario	*Expansion*	1.05	0.96	24.9	82:Q1-82:Q4	83:Q1-90:Q2
	Recession	-1.66	0.68	3.1	90:Q3-91:Q1	91:Q2-
Manitoba	*Expansion*	0.62	0.96	26.7	80:Q2-80:Q3	80:Q4-82:Q2
	Recession	-1.69	0.59	2.4	82:Q3-82:Q4	83:Q1-90:Q3
					90:Q4-91:Q1	91:Q2-
Saskatchewan	*Expansion*	N/A	N/A	N/A	N/A	N/A
	Recession	N/A	N/A	N/A	N/A	N/A
Alberta	*Expansion*	0.86	0.94	17.1	82:Q1-83:Q2	83:Q3-
	Recession	-0.87	0.57	2.3		
BC	*Expansion*	0.70	0.96	25.3	82:Q1-82:Q3	82:Q4-90:Q3
	Recession	-2.15	0.46	1.8	90:Q4-91:Q1	91:Q2-

The results obtained with Markov-switching models suggest that New Brunswick, Québec, Ontario and British Columbia experienced two recessions in the last two decades, the same number as Canada. The first recession occurred in the early 1980s and the next one in the early 1990s. The timing of both recessions in these provinces coincides with Canada. Furthermore, the models suggest that the duration of the recessions was somewhat shorter in the four provinces.

For the remaining provinces, the business cycle characteristics are different than for Canada. The Markov-switching models gives one less recession for Alberta and Nova Scotia (in the early 1980s), one more for Newfoundland and Manitoba, and two more for Prince Edward Island. For Saskatchewan, we were unable to find a chronology of the business cycle because convergence was not achieved during the estimation, and thus, the parameters could not be estimated. Again, see appendix A (page 39) for graphs of inferred probabilities.

3. CONSTRUCTION OF THE LEADING ECONOMIC INDEXES

Over the past forty years, research on cyclical indicators has focused mainly on the development of national indexes. Sub-national or regional indexes have gained in popularity since the middle of the 1980s when they were introduced by Phillips (1988) and Crone (1994) to provide a synthetic measure of future economic activity for some U.S. states. For Canadian provinces, the assessment of short-term economic outlook is still very difficult and challenging.[6]

This section presents leading economic indexes that will permit to gauge the future state of economic activity in all provinces in Canada. The section is organized as follows. The first part explains how they were constructed with the traditional NBER methodology. The second part shows the historical profile of the leading economic index for each province.

3.1 Application of NBER methodology

The construction of a leading economic index with the NBER methodology involves five key steps, which are described in Table 3 (next page).[7]

In our view, the first two steps are the most important because the performance of a provincial leading economic index in anticipating the cyclical change in economic activity will depend on how successful we are in finding reliable leading indicators of provincial economic activity. The next three steps are algebraic operations on the components and the index itself. The appendix B (page 42) illustrates algebraically the construction of a leading economic index for a given province.

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[6] The Mouvement Desjardins introduced in early 1990s a leading economic index for the Québec economy.

[7] This method is well described in the *Handbook of Cyclical Indicators* index published by the U.S. Department of Commerce.

Table 3
Constructing a Leading Economic Index with the NBER methodology

Step	Description
One	Choice of the reference series and determination of chronology of cyclical peaks and troughs.
Two	Identification of economic sectors, list of potential leading indicators and assessment and selection of the components of the leading index.
Three	Standardization of components to prevent volatile series from dominating the change in the leading index.
Four	Aggregation of standardised components into a leading index.
Five	Trend adjustment of the leading index to ensure that its historical profile is similar to the reference series.

Note: The description is draw from Zarnowitz and Boschan (1975).

More formally, the process we followed to build a leading economic index for each province is discussed thereafter. It involves:

- The identification of economic sectors and of potential leading indicators.
- The evaluation and selection of the components of the leading economic indexes.

3.1.1 Economic sectors and potential leading indicators

This section describes the economic sectors (or process) the leading economic indexes will be covering and presents the potential leading indicators for each sector.

Economic sectors

Seven economic sectors were identified for each province, covering a large spectrum of economic activity. They are the consumption sector, residential investment sector, non-residential investment sector, inventory sector, foreign sector, monetary and financial sector, and labour sector.

Potential leading indicators

In contrast to a national economy, where a large number of high frequency indicators are available, we have access to a very limited number of potential leading variables for the provinces. Table 4 (page 13 to 15) lists them by economic sector for each province. All series are quarterly and seasonably adjusted. They are described thereafter.

Leading indicators for consumer sector

Consumer spending is the most important component of economic activity. It accounts for a substantial share of the economy, more than half of provincial real GDP on average. Before making a consumption decision, households consider many factors, notably the cost of borrowing, personal financial situation and job security. Thus, a change in consumer attitudes, caused by a change in one or more of these factors, will tend to lead to a change in consumer spending.

Data on consumer attitudes is released regularly by the Conference Board of Canada. The data is available quarterly for the following regions: Atlantic, Québec, Ontario, Prairies and British Columbia. It is not available for each province of the Atlantic and Prairie regions. We thus simply assume that a change in consumer attitudes in each of these provinces is the same as for the corresponding region.

The Conference Board surveys households on four questions: current and future financial situations, employment prospects, and whether now is a good or bad time to make a major purchase. After the survey is done, they compile the results and release a value of consumer attitudes, which is a simple average of the net responses to the four questions indexed to 1991. Thus, the confidence series combines information about past, present and future. Using the responses to some of these four questions, one could build an index that is only forward looking. This was what we did by combining the net responses to the questions on future financial positions and employment prospects. The forward-looking index is calculated the same way as the index released by the Conference Board.

For all provinces, two series are considered as potential leading indicators for the consumer sector. They are the actual and forward-looking indexes of consumer attitudes.

Leading indicators for residential investment sector

Residential investment includes three components: new housing construction, renovations and improvement and commissions from the sale of existing houses. New housing construction is the most important component, accounting for about half of residential investment on average in all provinces. Investment in new housing construction involves a long process that extends in general over many months. The first or early stage of that process is the issuing of a building permit and the last stage is the completion of the housing unit. Only at the last stage is the residential investment recorded in the national accounts. Hence, the issuance of a building permit will tend to lead investment spending in new housing construction.

For all provinces, three series are considered as potential leading indicators for new housing investment. They are the number of building permits, the real value of building permits (1992 dollars), and the smoothed real value of building permits. The actual or forward-looking index of consumer attitudes could also be considered as a potential leading indicator for the other two components of residential investment.

Leading indicators for non-residential investment sector

Investment in non-residential construction is also spread over a period of time, but the number of months required to complete the project is generally much longer. As with residential construction, the first or early stage of the investment process is the decision to obtain a building permit. Thus, the issuing of the permit constitutes a leading indicator of non-residential investment.

For all provinces, two series are considered as potential leading indicators for investment in non-residential construction -- the real value of building permits (in 1992 dollars) and the smoothed real value of building permits. For Alberta, we also consider the number of oil and gas well licenses issued as another candidate leading indicator.

Leading indicators for inventory sector

Prices of raw materials are often used as leading indicators of inventory sector. The rationale is that prices are assumed to reflect changes in supply and demand in the process of increasing or reducing stocks of raw materials.

For all provinces, two series are considered as potential leading indicators. They are the Finance's index of commodity prices in Canadian and U.S. dollars. The index is in real terms and available for each province. Data on stocks and stocks-to-sales ratio are not available by province.

Leading indicators for foreign sector

Canadian provinces exported a significant part of their output to foreign countries. Based on 1999 data, Ontario is the most dependant on foreign market with merchandise exports accounting for 49 per cent of GDP. For all other provinces, the share in GDP varies between 18 per cent (Nova Scotia) and 34 per cent (New Brunswick). Thus, a change in foreign demand will have a significant effect on economic activity in all provinces.

For all provinces, four series are considered as potential leading indicators for the foreign sector. They are Finance Canada's and U.S. Conference Board's leading economic index for the U.S., OECD's leading economic index for the fifteen largest European countries and Japan, and OECD's expected business conditions survey for Japan. Because Saskatchewan and Alberta are major exporters of crude oil and natural gas, we also considered the number of oil and gas wells drilled in the U.S. as a potential leading indicator for these two provinces.

Leading indicators for monetary and financial sector

Many studies have shown that monetary and financial variables are strong leading indicators of national business cycle turning points. They are also likely leading indicators of cyclical changes in regional economies.

Monetary indicators

For all provinces, three series are considered as potential leading monetary indicators. They are real M1, real M2 and real M3. For a given province, the nominal monetary aggregates are deflated with all-items CPI index.

Financial indicators

For all provinces, three series are considered as potential leading financial indicators. They are real short- and long-term interest rates and the slope of the yield curve.

Different short- and long-term maturities were used. For a given province, all real interest rates are calculated using the contemporary year-over-year percentage change in the corresponding all-items CPI index. The slope of the yield curve is defined as the long-term interest rate minus the short-term interest rate. Again, different measure of the slope of the yield curve was defined using different short- and long-term maturities. In contrast to monetary aggregates and interest rates, the slope of the yield curve is the same for all provinces.

Stock market indicators

Stock market indexes are often included in leading economic indexes, such as in Statistics Canada's leading indicator.[8] However, Rhoades (1982) showed that a stock market index tends to give more false signals of a recession that other leading indicators.

For all provinces, the real TSE aggregate and sub-aggregate indexes were considered as potential leading indicators. For a given province, the TSE index is deflated with the all-items CPI index.

Leading indicators for labour sector

The help wanted index gives the number of help wanted advertisements in the classified section of major newspapers across Canada. When an economy begins to slow down, employers tends to reduce the number of new hires, which is usually preceded by a decline in the number of vacancies being advertised in the newspapers.

For all provinces, only the help wanted index series is considered as a potential leading indicator for the labour sector.

[8] The TSE stock market index is a component of the Statistics Canada's leading economic index.

Table 4: Potential Leading Indicators by Economic Sectors and Provinces

	Economic Sectors						
	Consumption Sector	**Residential Investment Sector**	**Non-residential Investment Sector**	**Inventory Sector**	**Foreign Sector**	**Monetary/ Financial Sector**	**Labour Sector**
Nfld	Consumer attitudes, actual and forward-looking indexes	Building permits in units, real dollars and real dollars smoothed	Building permits in real dollars and real dollars smoothed	Finance's index of commodity prices, in both $CA and $US and in real terms	Leading economic index for U.S. and Europe (the second most important export market)	Real M1, real short- and long-term interest rates, yield curve, real TSE aggregate and sub-sector indexes	Help wanted index
PEI	Consumer attitudes, actual and forward-looking indexes	Building permits in units, real dollars and real dollars smoothed	Building permits in real dollars and real dollars smoothed	Finance's index of commodity prices, in both $CA and $US and in real terms	Leading economic index for U.S. and Europe (the second most important export market)	Real M1, real short- and long-term interest rates, yield curve, real TSE aggregate and sub-sector indexes	Help wanted index
Nova Scotia	Consumer attitudes, actual and forward-looking indexes	Building permits in units, real dollars and real dollars smoothed	Building permits in real dollars and real dollars smoothed	Finance's index of commodity prices, in both $CA and $US and in real terms	Leading economic index for U.S. and Europe (the second most important export market)	Real M1, real short- and long-term interest rates, yield curve, real TSE aggregate and sub-sector indexes	Help wanted index
New Brunswick	Consumer attitudes, actual and forward-looking indexes	Building permits in units, real dollars and real dollars smoothed	Building permits in real dollars and real dollars smoothed	Finance's index of commodity prices, in both $CA and $US and in real terms	Leading economic index for U.S. and Europe (the second most important export market) U.S. residential building permits	Real M1, real short- and long-term interest rates, yield curve, real TSE aggregate and sub-sector indexes	Help wanted index

Note: All the series are from Statistics Canada's CANSIM database, U.S. DRI database, and OECD database, except for the following variables. The residential and non-residential building permit series are unpublished data provided by Statistics Canada. Data on consumer attitudes are from the Conference Board of Canada WebLinx site. Alberta Energy Department provided data on well licenses issued. All the series are seasonally adjusted.

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	Economic Sectors						
	Consumption Sector	**Residential Investment Sector**	**Non-residential Investment Sector**	**Inventory Sector**	**Foreign Sector**	**Monetary/ Financial Sector**	**Labour Sector**
Québec	Consumer attitudes, actual and forward-looking indexes	Building permits in units, real dollars and real dollars smoothed	Building permits in real dollars and real dollars smoothed	Finance's index of commodity prices, in both $CA and $US and in real terms	Leading economic index for U.S. and Europe (the second most important export market)	Real M1, real short- and long-term interest rates, yield curve, real TSE aggregate and sub-sector indexes	Help wanted index
Ontario	Consumer attitudes, actual and forward-looking indexes	Building permits in units, real dollars and real dollars smoothed	Building permits in real dollars and real dollars smoothed	Finance's index of commodity prices, in both $CA and $US and in real terms	Leading economic index for U.S. and Europe (the second most important export market)	Real M1, real short- and long-term interest rates, yield curve, real TSE aggregate and sub-sector indexes	Help wanted index
Manitoba	Consumer attitudes, actual and forward-looking indexes	Building permits in units, real dollars and real dollars smoothed	Building permits in real dollars and real dollars smoothed	Finance's index of commodity prices, in both $CA and $US and in real terms	Leading economic index for U.S. and Japan (the second most important export market)	Real M1, real short- and long-term interest rates, yield curve, real TSE aggregate and sub-sector indexes	Help wanted index
Sask.	Consumer attitudes, actual and forward-looking indexes	Building permits in units, real dollars and real dollars smoothed	Building permits in real dollars and real dollars smoothed	Finance's index of commodity prices, in both $CA and $US and in real terms	Leading economic index for U.S. and Europe (the second most important export market) Oil and gas wells drilled in the U.S.	Real M1, real short- and long-term interest rates, yield curve, real TSE aggregate and sub-sector indexes	Help wanted index

Note: All the series are from Statistics Canada's CANSIM database, U.S. DRI database, and OECD database, except for the following variables. The residential and non-residential building permit series are unpublished data provided by Statistics Canada. Data on consumer attitudes are from the Conference Board of Canada WebLinx site. Alberta Energy Department provided data on well licenses issued. All the series are seasonally adjusted.

Table 4: Potential Leading Indicators by Economic Sectors and Provinces

	Economic Sectors						
	Consumption Sector	**Residential Investment Sector**	**Non-residential Investment Sector**	**Inventory Sector**	**Foreign Sector**	**Monetary/ Financial Sector**	**Labour Sector**
Alberta	Consumer attitudes, actual and forward-looking indexes	Building permits in units, real dollars and real dollars smoothed	Building permits in units, real dollars and real dollars smoothed Oil and gas wells permits in Alberta	Finance's index of commodity prices, in both $CA and $US and in real terms	Leading economic index for U.S. and Japan (the second most important export market) Oil and gas wells drilled in the U.S.	Real M1, real short- and long-term interest rates, yield curve, real TSE aggregate and sub-sector indexes	Help wanted index
BC	Consumer attitudes, actual and forward-looking indexes	Building permits in units, real dollars and real dollars smoothed	Building permits in real dollars and real dollars smoothed	Finance's index of commodity prices, in both $CA and $US and in real terms	Leading economic index for U.S. and Japan (the second most important export market)	Real M1, real short- and long-term interest rates, yield curve, real TSE aggregate and sub-sector indexes	Help wanted index

Note: All the series are from Statistics Canada's CANSIM database, U.S. DRI database, and OECD database, except for the following variables. The residential and non-residential building permit series are unpublished data provided by Statistics Canada. Data on consumer attitudes are from the Conference Board of Canada WebLinx site. Alberta Energy Department provided data on well licenses issued. All the series are seasonally adjusted.

3.1.2 Evaluation and selection

The second step of the NBER methodology also involves the evaluation of the potential leading indicators and a selection of the components for each index. The evaluation is done over the period 1979 to 2000, which includes only two recessions for most provinces. This small number of cyclical experiences implies that our judgment would be a non-negligible ingredient in the screening process of the candidate indicators than it would have been the case if we have had more cyclical changes.

Evaluation of potential leading indicators

For all provinces, the potential leading indicators were evaluated the following way.

- First, the historical movement of each potential leading indicator is visually inspected to detect the relationship with the cyclical turning points of the coincident index.
- Second, the empirical relationship of each potential leading indicator with the business cycle is determined. This means the computation of lead/lag at each cyclical turning point, average lead/lag at all cyclical turning points, the number of missing cycles and the number of false signals.
- Third, the correlogram of each potential leading indicator (in percentage change) with the coincident index (in percentage change) is examined over all the data points of the business cycle. A potential leading indicator should have higher correlation with the reference series at a lead greater than zero.
- Last, we determined if each potential leading indicator is statistically a significant leading indicator of the coincident index. This is done with the Granger causality test.

Selection of leading indicators

All the individual leading indicators were screened as described above and the goal was to have a leading economic index for each province with the following properties:

- All economic sectors must be represented in the leading index.
- Each leading indicator must lead on average the cyclical turning points of the coincident index, must not have missing cycles and must not have produced a large number of false signals.
- Each individual leading indicator must "Granger-cause" the coincident index.
- Each individual leading indicator shall have more information content in predicting growth in the coincident index than other potential indicators from the same sector.

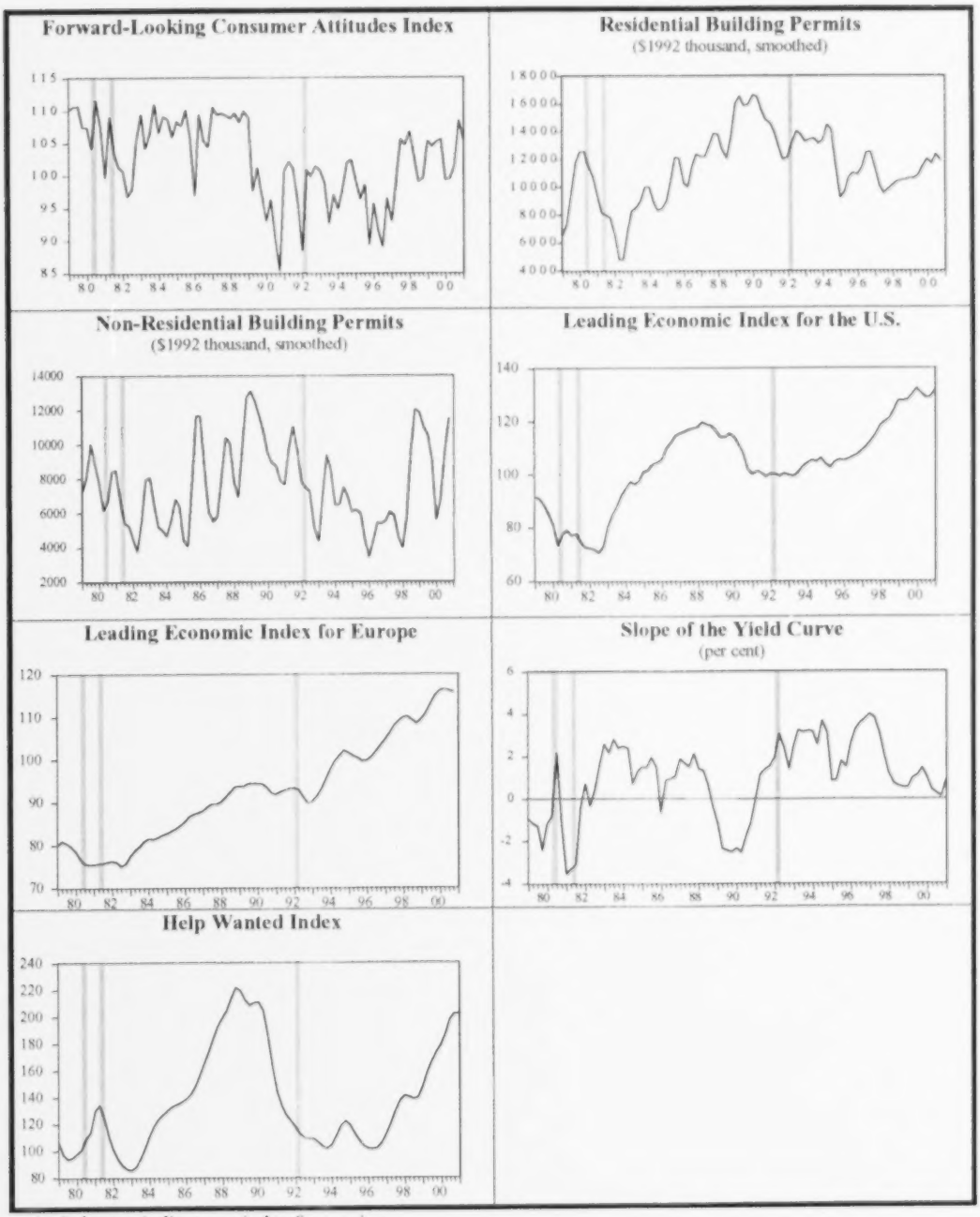
Table 5 (page 17) lists the components of the leading index for each province. Charts 1 to 10 (page 18 to 27) shows the historical movement of the leading economic index by province. The shaded areas are recession periods, as determined by the authors.

Table 5
Components of the Leading Economic Indexes by Province

	Nfld.	PEI	NS	N. -B.	Québec	Ontario	Man.	Sask.	Alb.	B.C.
Forward-looking consumer attitudes index	✓	✓[1]	✓	✓	✓	✓	✓	✓	✓	✓
Real residential building permits, smoothed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Real non-residential building permits, smoothed	✓	✓	✓	✓[2]	✓	✓	✓	✓	✓	✓
Oil and gas wells permits in Alberta									✓	
Index of real commodity prices			✓					✓	✓	✓
Leading economic index for the U.S.	✓	✓	✓		✓	✓	✓	✓[3]	✓[3]	✓
Residential building permits for the U.S.				✓						
Oil and gas wells drilled in the U.S.								✓	✓	
Leading economic index for Europe	✓									
Leading economic index for Japan							✓			✓
Slope of the yield curve	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Help wanted index	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	**7**	**6**	**7**	**6**	**6**	**6**	**7**	**8**	**9**	**8**

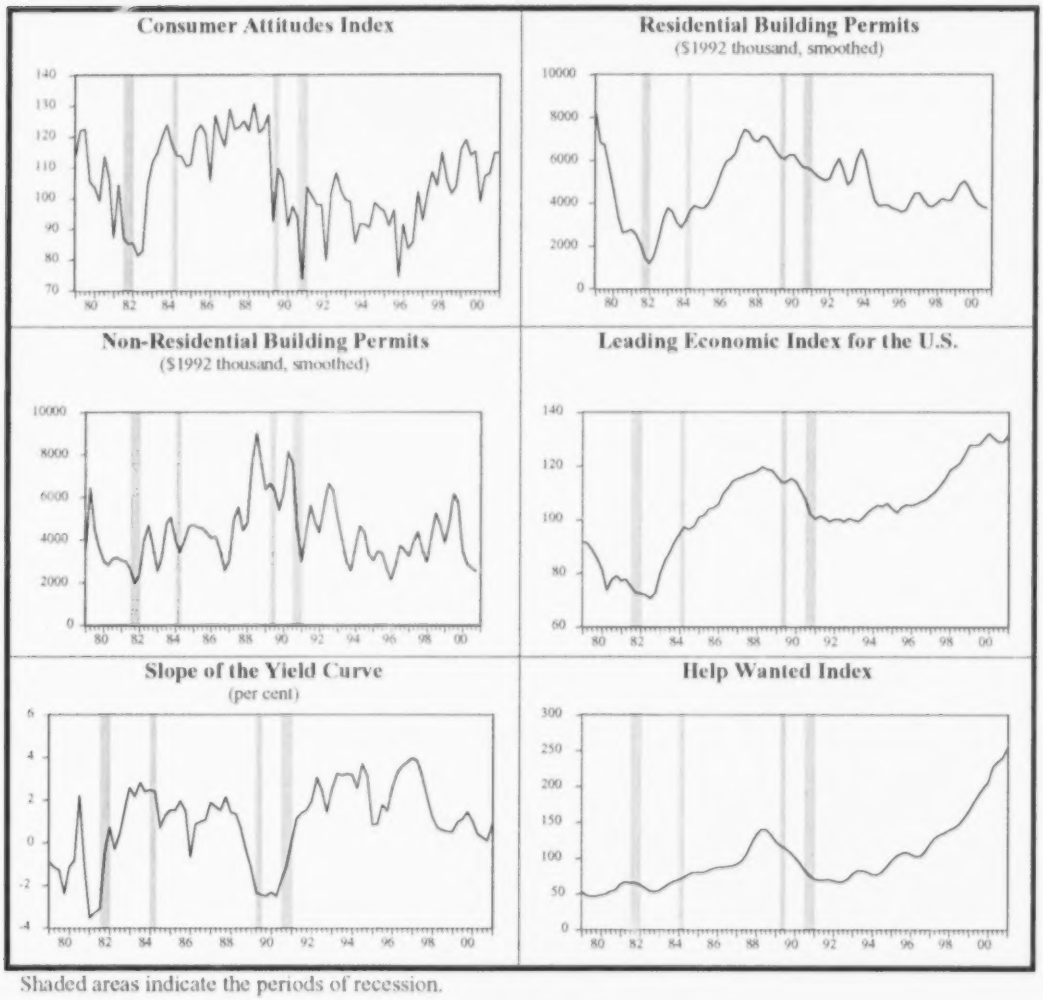
1. Actual index.
2. Seasonally adjusted, not smoothed.
3. Form U.S. Conference Board.

Chart 1
Selected Individual Leading Indicators for Newfoundland



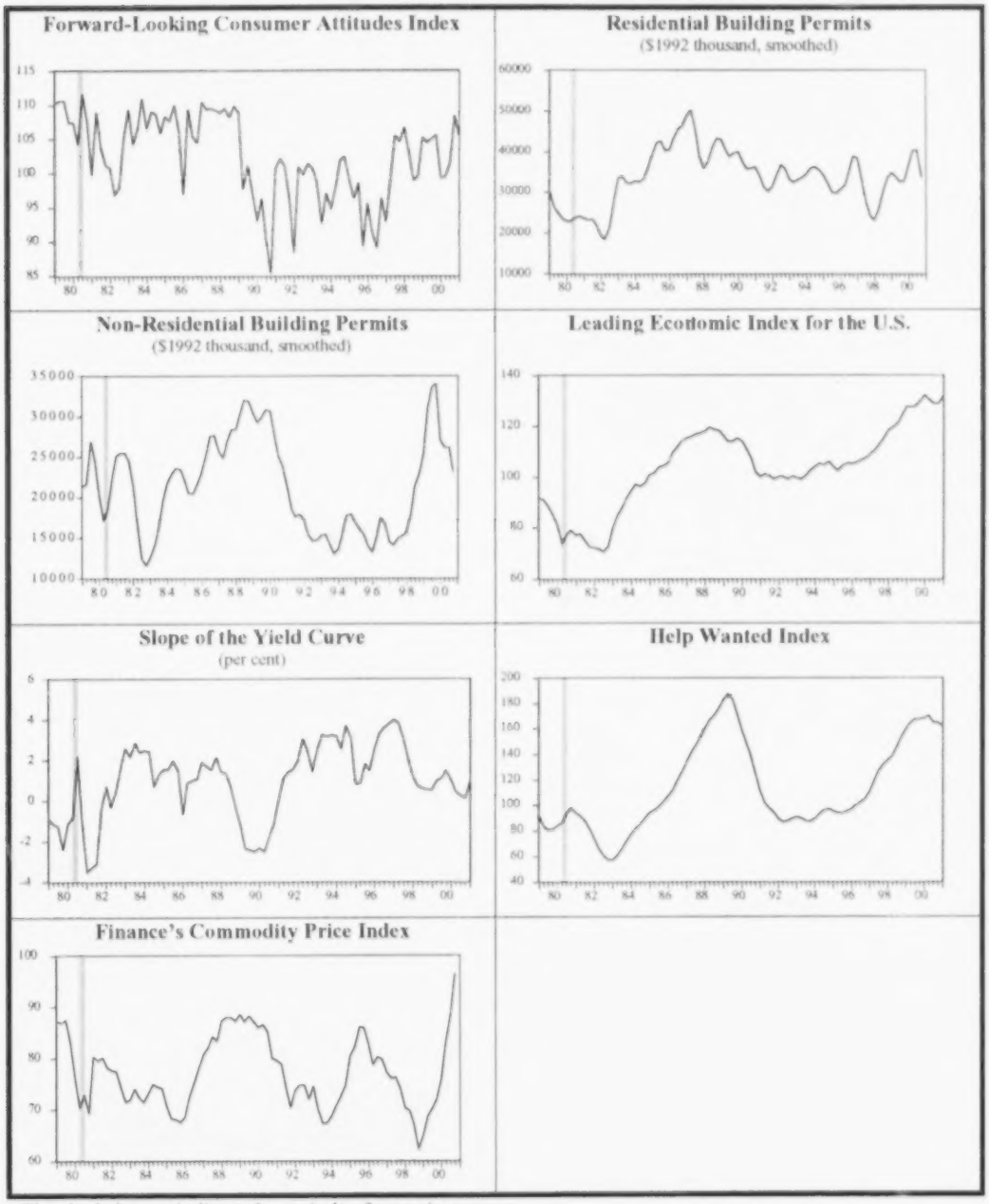
Shaded areas indicate periods of recession.

Chart 2
Selected Individual Leading Indicators for Prince Edward Island



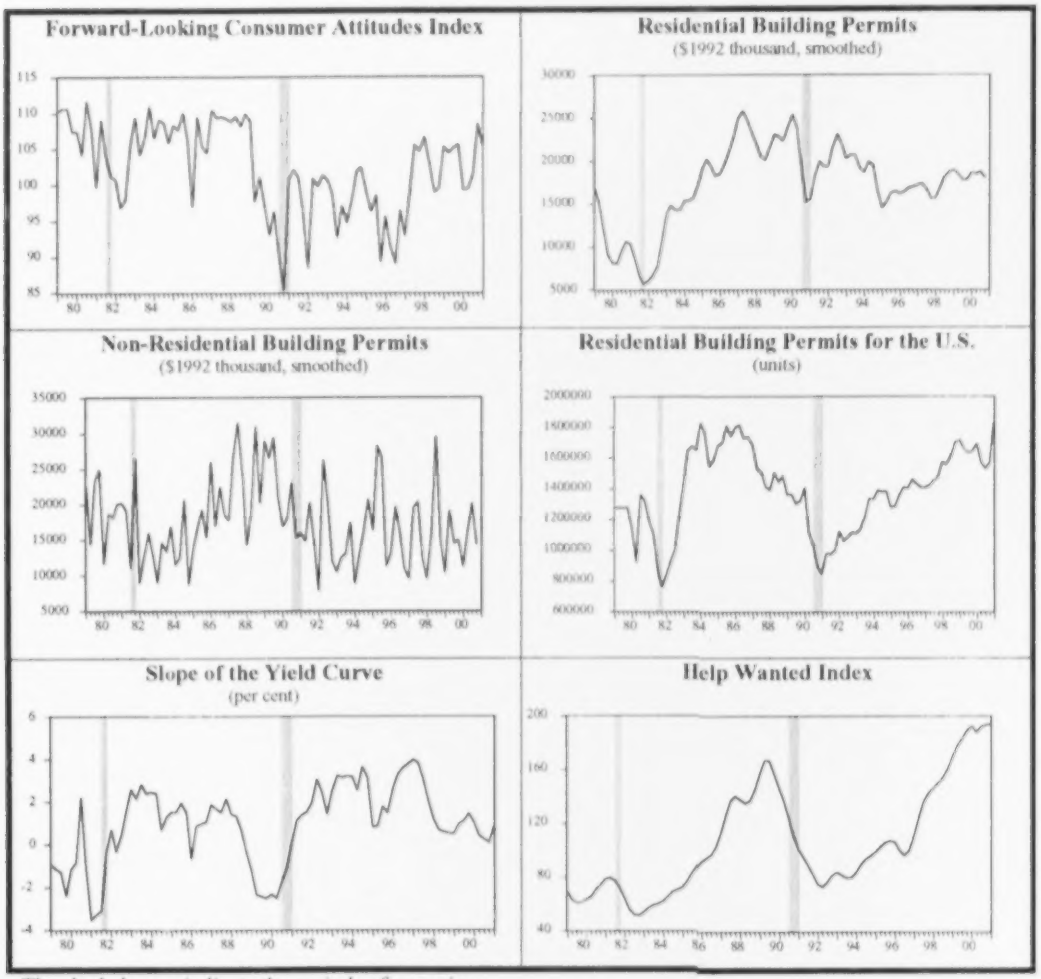
Shaded areas indicate the periods of recession.

Chart 3
Historical Profile of the Selected Leading Indicators for Nova Scotia



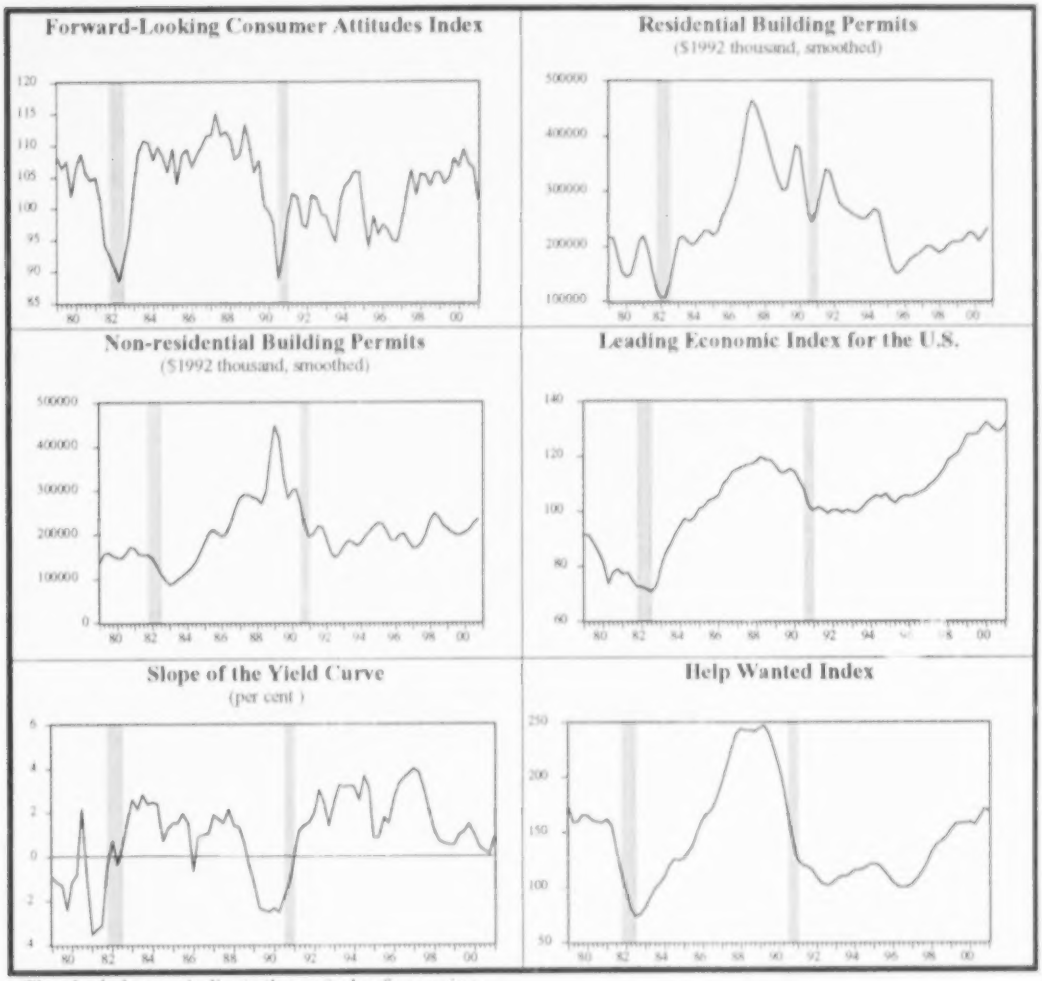
The shaded areas indicate the periods of recession.

Chart 4
Historical Profile of the Selected Leading Indicators for New Brunswick



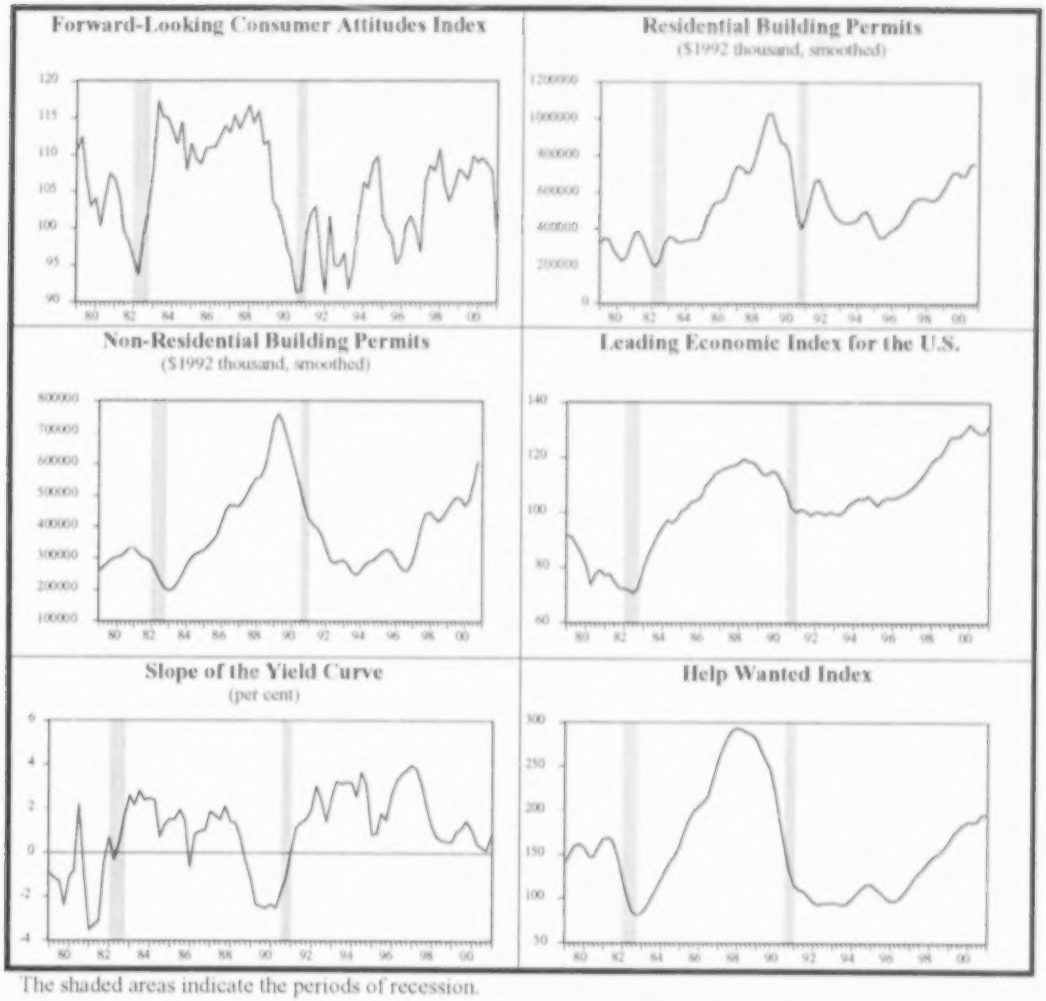
The shaded areas indicate the periods of recession.

Chart 5
Historical Profile of the Selected Leading Indicators for Québec



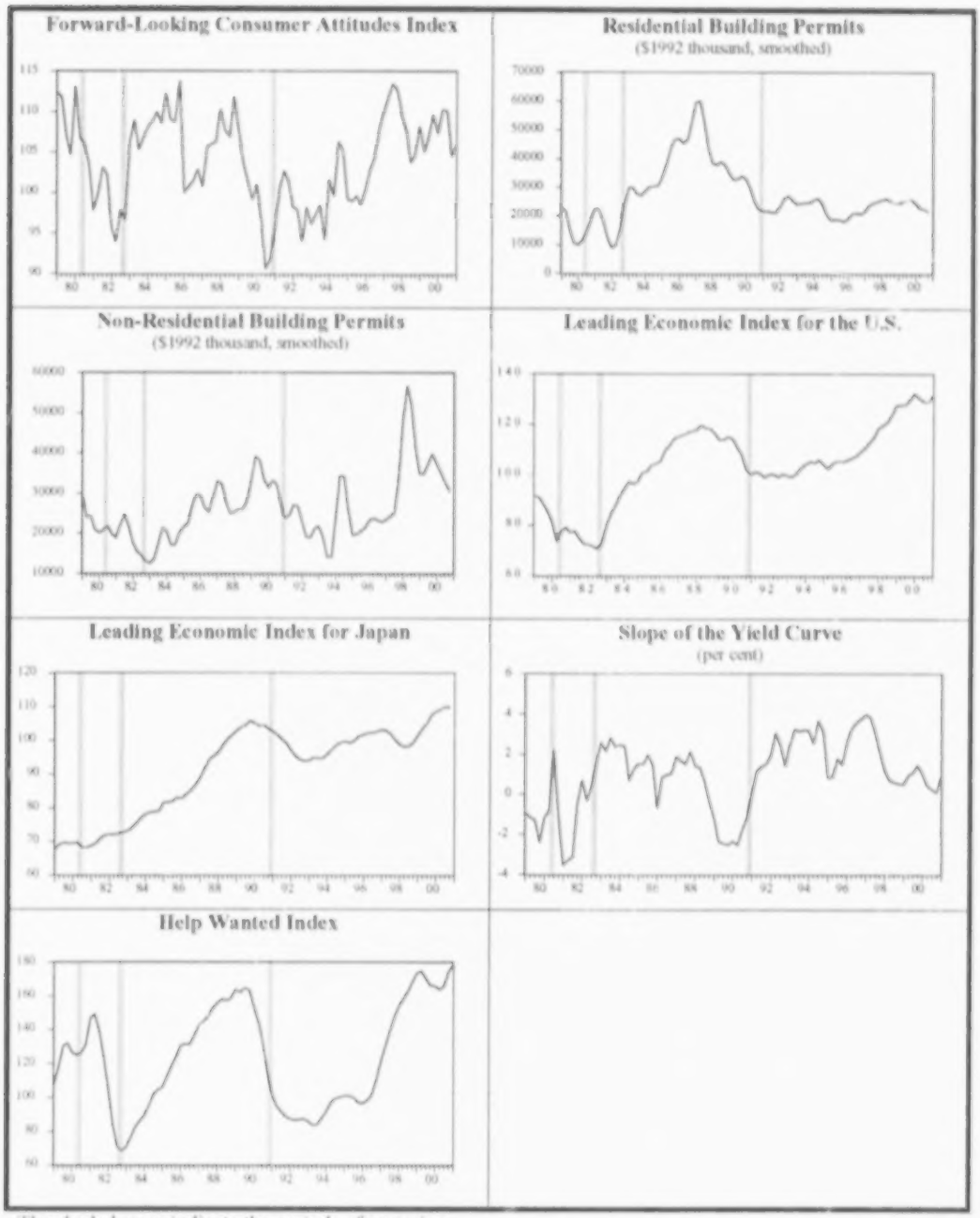
The shaded areas indicate the periods of recession.

Chart 6
Selected Individual Leading Indicators for Ontario



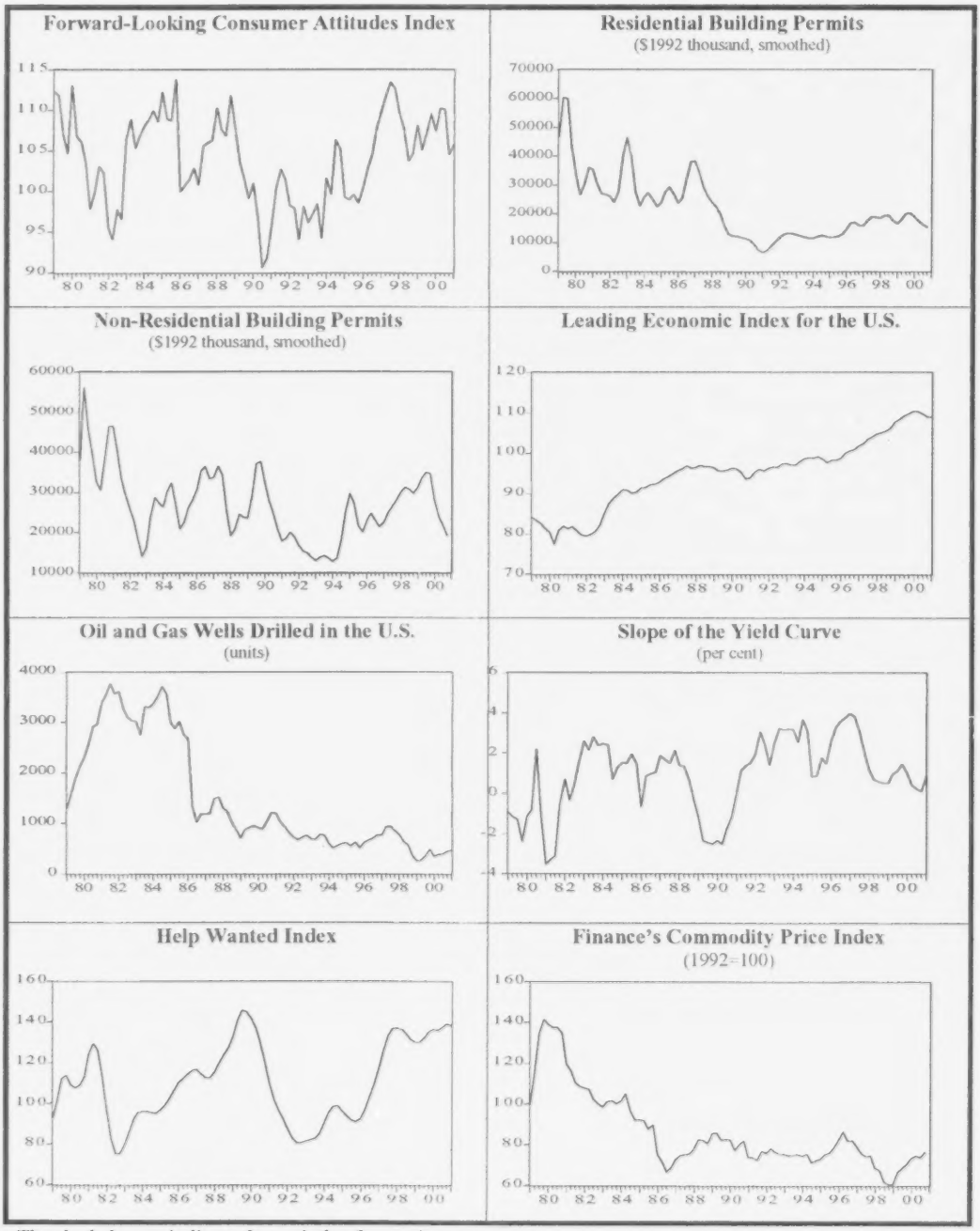
The shaded areas indicate the periods of recession.

Chart 7
Selected Individual Leading Indicators for Manitoba



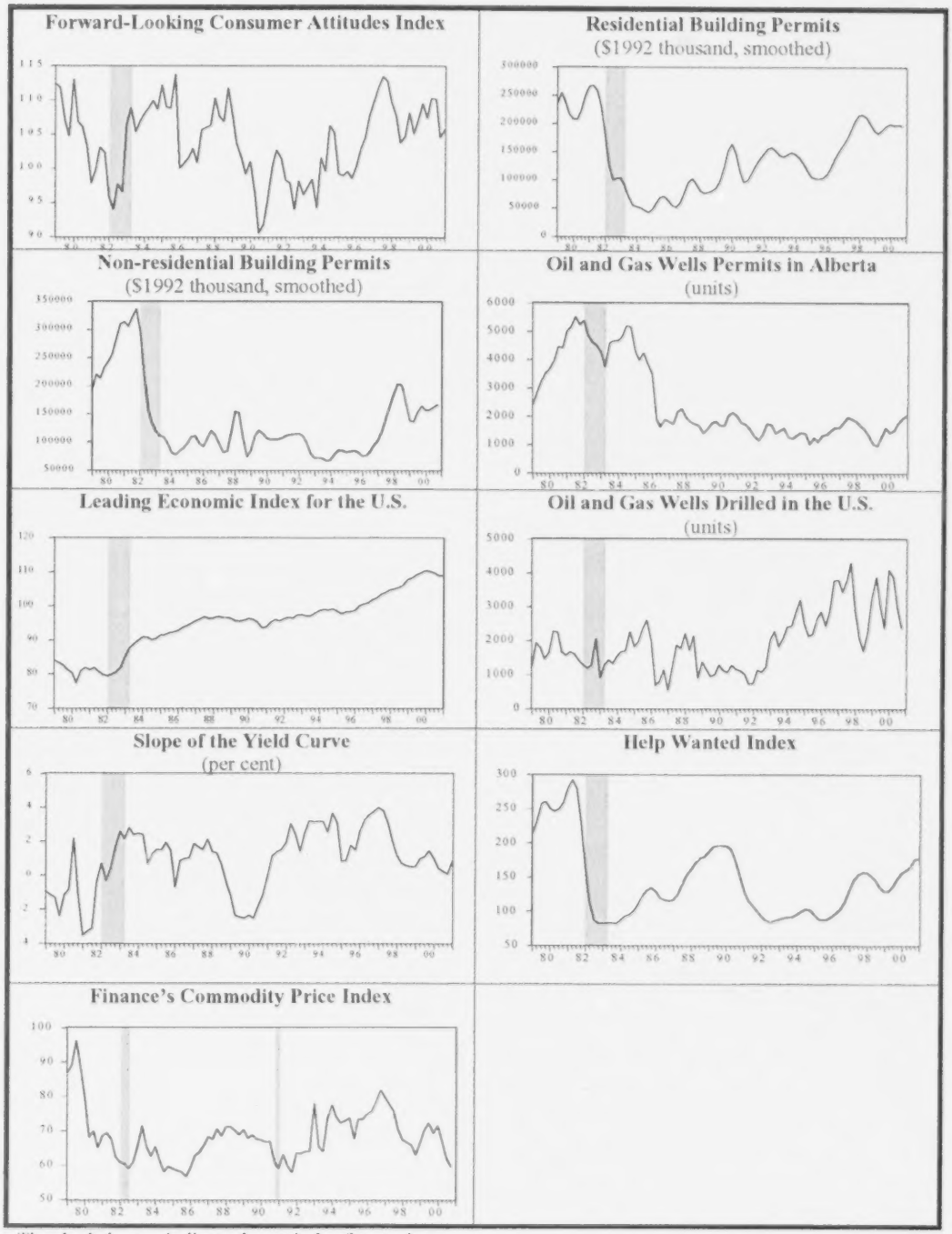
The shaded areas indicate the periods of recession.

Chart 8
Selected Individual Leading Indicators for Saskatchewan



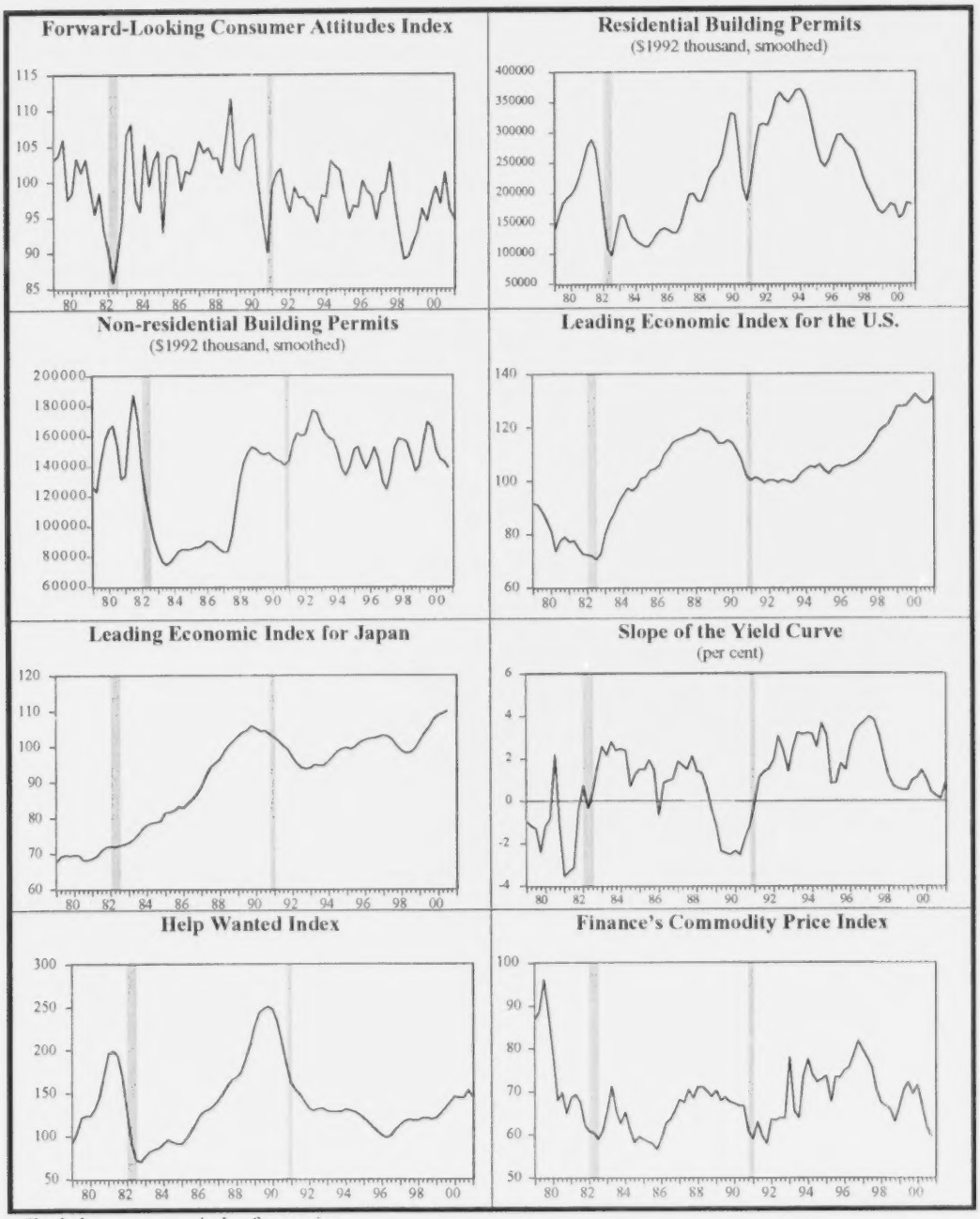
The shaded areas indicate the periods of recession.

Chart 9
Selected Individual Leading Indicators for Alberta



The shaded areas indicate the periods of recession.

Chart 10
Selected Individual Leading Indicators for British Columbia



Shaded areas are periods of recession.

3.2 Historical profile of the leading economic indexes

For all provinces, the leading economic index is a weighted sum of the components from Table 5. Starting in the first quarter 1992, the weights are estimated using only past information. The algebraic operations used to construct the indexes are described in Appendix B (page 42). The weights are given in Appendix D (page 51).

Historical profile

Charts 11 and 12 (page 30 and 31) show the level and percentage change in the leading economic index for each province since the second quarter of 1979. Visual inspection reveals that:

- The movement in the level of leading economic indexes closely follows the movement in the level of the coincident indexes.

- The cyclical turning points in the leading economic indexes tend to lead the cyclical turning points in the coincident indexes.

- For all provinces, the leading economic index "Granger-cause" the coincident index (Table 6). This suggests that each leading index provide information over and above what is already contained in the coincident index.

- For most provinces, the leading economic index has more predictive content in forecasting the coincident index when lagged one period (Table 7). The predictive content is the highest for Ontario followed by Québec and the lowest for Newfoundland. For all provinces, the leading economic index still has significant predictive content at period t-2.

4. EVALUATION OF THE LEADING ECONOMIC INDEXES

The leading economic indexes were evaluated in terms of the capacity to signal in advance cyclical turning points and forecast growth in the coincident indexes.

4.1 Signaling in advance cyclical turning points

The first traditional way to evaluate a leading economic index is to assess the ability to give advance signals of recessions (expansions). To do the evaluation, we must define a rule to forecast cyclical turning points. A rule that has been used very often in the past is three consecutive monthly declines (increases), or a one quarterly decline (increase), in a leading economic index signals an upcoming recession (expansion). Because that rule relies only on the sign of the change without regard to its size, we choose to specify another rule. That rule is described thereafter. For a given province, one quarterly decline (increase) in the leading economic index associated with a decline (increase) in more than half of the components of the index is a signal of a recession (expansion).

Table 6
Do the Leading Economic Indexes "Granger Cause" the Coincident Indexes?

	Granger causality*	
	lags = 4	**lags = 8**
Newfoundland	yes	yes
Prince Edward Island	yes	yes
Nova Scotia	yes	yes
New Brunswick	yes	yes
Québec	yes	yes
Ontario	yes	yes
Manitoba	yes	yes
Saskatchewan	yes	yes
Alberta	yes	yes
British Columbia	yes	yes

*5% level of confidence.

Table 7
Goodness of Fit between Leading and Coincident Economic Indexes

	Adjusted R^2			
	$k = 0$	$k = 1$	$k = 2$	$k = 3$
Newfoundland	0.101	0.290	0.252	0.040
Prince Edward Island	0.284	0.260	0.082	0.022*
Nova Scotia	0.202	0.476	0.304	0.093
New Brunswick	0.248	0.309	0.094	0.008*
Québec	0.406	0.568	0.485	0.364
Ontario	0.590	0.662	0.442	0.266
Manitoba	0.395	0.536	0.431	0.225
Saskatchewan	0.171	0.275	0.108	-0.005*
Alberta	0.519	0.502	0.250	0.078
British Columbia	0.393	0.494	0.207	0.024*

Note: For each province, the adjusted R^2 is taken from the regression, $\Delta CEI_t = \beta_0 + \beta_1 \Delta LEI_{t-k} + \varepsilon_t$, $k = 0$, 1, 2 and 3. Shaded areas correspond to the highest adjusted R^2. The '*' means that the estimated coefficient β_1 is not significant à 5% confidence level.

Chart 11
Historical Profile of the Leading Economic Indexes

——— Coincident Index (right scale) ..... Leading Index (left scale)

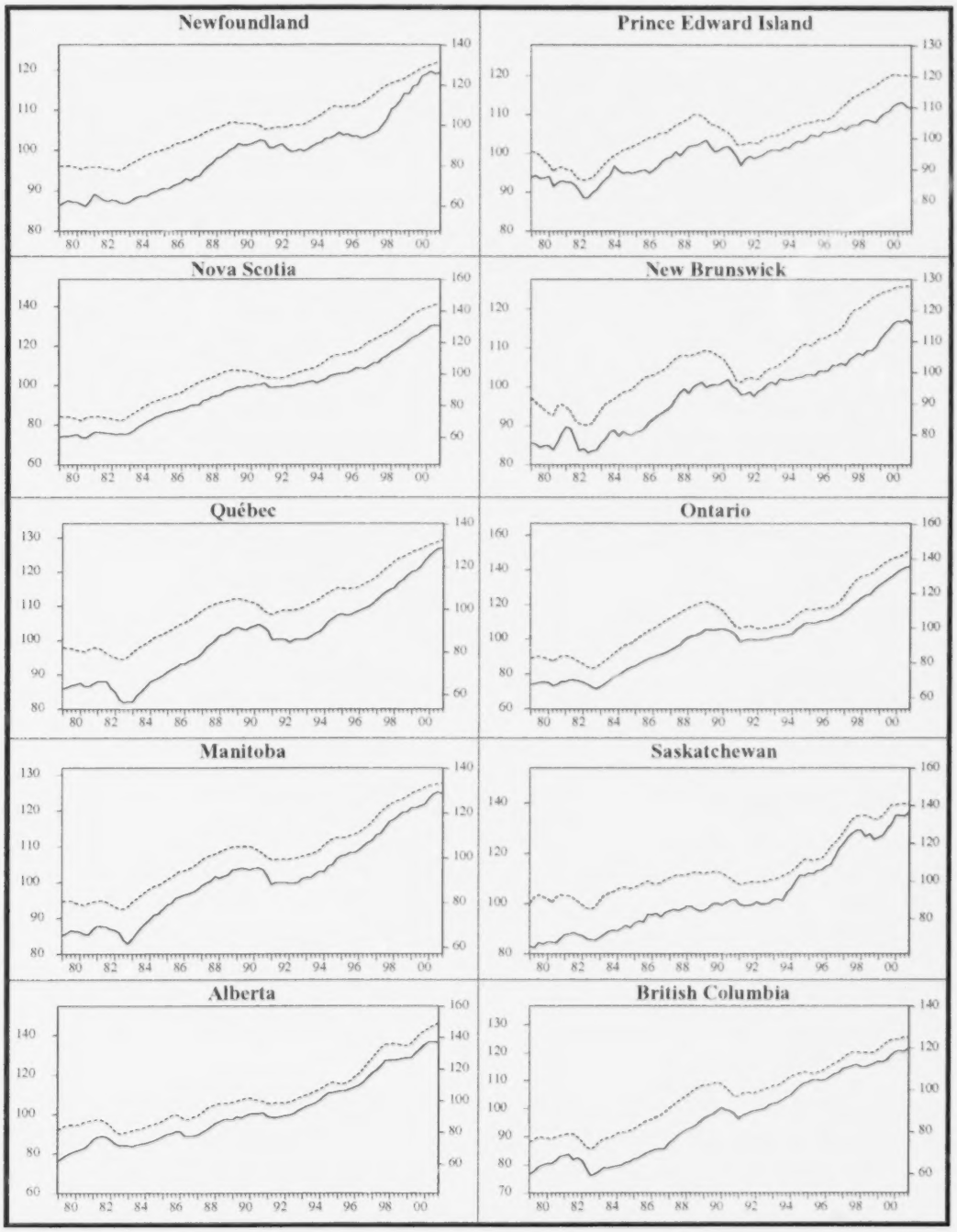
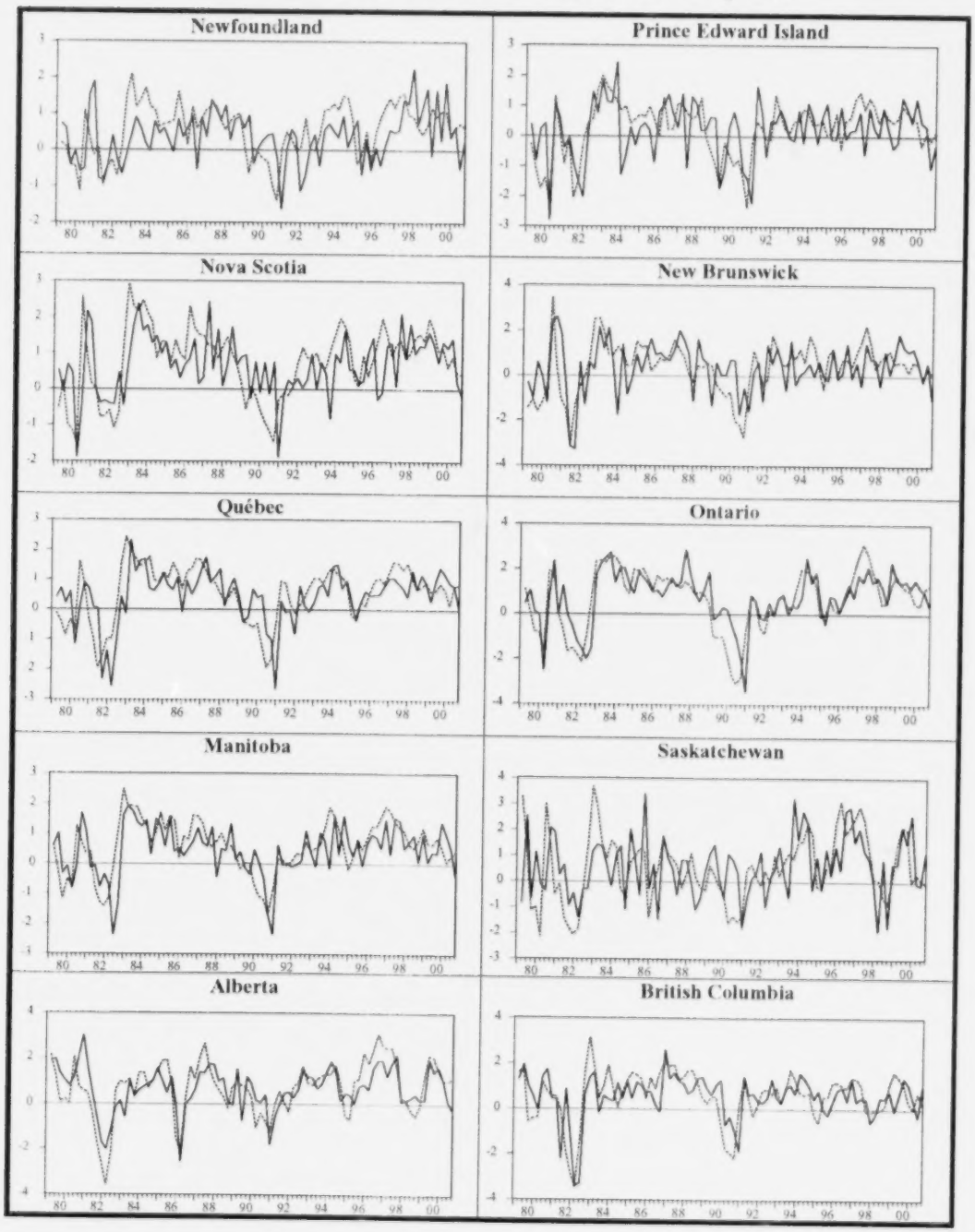


Chart 12
Percent Changes in Leading and Coincident Economic Indexes

Coincident Index ..... Leading Index



Based on the rule, Table 8 provides a summary of the performance of each provincial leading economic index in signaling in advance cyclical turning points. More details by province are provided in Appendix C (page 45). For a given province, the Table gives the average lead or lag at peaks and troughs, the number of advance signals of recessions relative to the number of recessions, the number of missing cycles and the number of false signals of recessions. The lead or lag at cyclical turning points and the number of false signals were determined with the rule described above. The "-"indicates a lead and "+" a lag. The lead or lag is the difference between the cyclical peak (trough) in the leading economic index and the cyclical peak (trough) in the coincident economic index.

The analysis of Table 8 reveals the following key facts:

- First, for all provinces (except Saskatchewan), the leading economic index gives on average an advance signal of a recession. The maximum average forecasting lead at peak is 4 quarters for Ontario and the minimum is 1.5 quarters for Newfoundland.
- Second, for six provinces, the leading economic index gives on average an advance signal of a cyclical trough. And the forecasting lead at trough is shorter.
- Third, for 7 of the 10 provinces, the leading economic indexes provided an advance warning of all recessions in the last two decades. The exceptions are Newfoundland and Prince Edward Island. The leading economic index for Newfoundland missed one of two recessions and two of four recessions for Prince Edward Island.
- Fourth, for all provinces, the leading economic index provided false signals of a recession. On average, they gave 3 false signals of a recession in the last two decades.

Table 8
Performance in Signaling Cyclical Turning Points in the Coincident Indexes

Province	Average lead (-) /lag (+) at cyclical peak and trough		Number of warning signals of recessions	Number of missing recessions	Number of false signals of recessions
	Peaks	*Troughs*			
Newfoundland	-1.5	+1.0	2 out of 3	1	3
PEI	-2.5	+3.0	2 out of 4	2	2
Nova Scotia	-2.0	-1.0	1 out of 1	0	4
NB	-3.5	+1.0	2 out of 2	0	4
Québec	-3.5	-0.5	2 out of 2	0	2
Ontario	-4.0	-0.5	2 out of 2	0	3
Manitoba	-3.3	-1.0	3 out of 3	0	3
Saskatchewan	N/A	N/A	N/A	N/A	N/A
Alberta	-2.0	-3.0	1 out of 1	0	4
BC	-2.5	-0.5	2 out of 2	0	4

4.2 Predicting growth in the coincident indexes

In this section, we evaluate the leading economic indexes with respect to their capacity to predict out-of-sample growth in the coincident economic indexes for a forecast horizon of one quarter. The equation we used to forecast each provincial coincident index is described below. For each province, we simply estimate a leading indicator model that connects the growth rate of the coincident economic index (CEI) with the growth rate of the leading economic index (LEI) lagged by one quarter:

$$\Delta CEI_t = \beta_0 + \beta_1 \Delta LEI_{t-1} + \varepsilon_t, \qquad [3]$$

For each province, the out-of-sample forecasting performance of the leading indicator model is compared to the out-of-sample prediction from an ARIMA model. The Hannan and Rissanen procedure was used to identify the ARIMA model for each provincial coincident index. They were identified over the period 1980:Q1 to 1991:Q4 and the same specification was used over the testing sample.

The recursive approach was used to produce the out-of-sample forecasts for the leading indicator and ARIMA models. In this approach, each model is estimated over the period 1980:Q1 to 1991:Q4. Then, a one-quarter-ahead forecast is computed for 1992: Q1. Next, each model is re-estimated with one more observation and another one-quarter-ahead forecast is computed. The same steps are repeated until the end of the sample, which is 2000:Q4

The forecasting performance of the leading indicator and ARIMA models is evaluated and compared based on four statistics. The first two are the root mean square forecast error (RMSE) and mean absolute error (MAE). The smaller is the RMSE and MAE, the more accurate is the forecast. The third statistic is the U-Theil inequality coefficient. If the ratio is less than unity, a forecast from the leading indicator or ARIMA model is superior to the forecast from the naïve model. Hence, the closer the U-Theil is to zero the better the forecasts from the leading indicator or ARIMA model relative to the naïve model. The last indicator is the confidence index.[9] It is the number of times a leading indicator or ARIMA model gives the correct direction of change in the coincident index as a percentage of the total number of changes.

Table 9 (next page) reports the results for leading indicator and ARIMA models with respect to the four statistics. Chart 13 (page 35) shows the forecasting performance of all leading indicator models. The forecasted values from the first quarter of 1992 are out-of-sample. Shaded areas indicate the model with the best forecasting performance. Based on the results from the Table with respect to the RMSE and MEA statistics, the conclusion is clear. For all provinces, except New Brunswick, growth in the leading economic indexes lagged one quarter is a superior predictor of growth in the coincident indexes than past

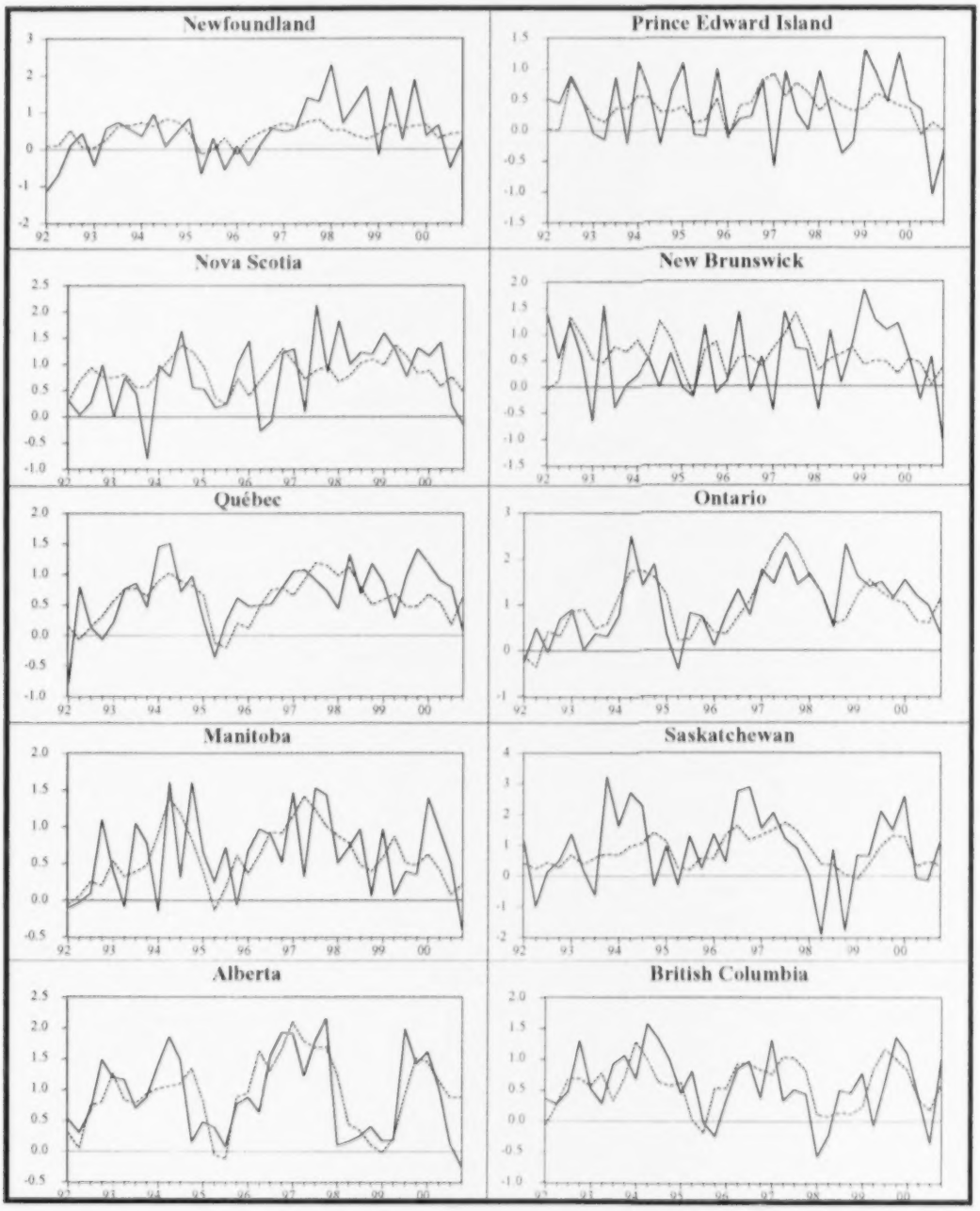
[9] The confidence index is the opposite of the confusion index. That index was used by Paquet, Fauvel and Zimmermann (1999) to evaluate forecasting models of labour market variables in Canada. They defined the confusion index as "the number of times a model gives incorrect directional predictions of a variable over a testing sample".

growth in the coincident indexes. The forecasting performance is most notable for Québec, Ontario, Manitoba, Alberta and BC (see Chart 13). Furthermore, the U-Theil statistics is lower for all leading indicator models. Lastly, the confidence index is higher for all leading indicator models, indicating that they were more successful in forecasting the direction of change in the coincident indexes.

Table 9
Summary of Out-of-Sample Forecasting Performance
Of the Leading Indicator and ARIMA Models

	Root Mean Square Error	Mean Absolute Error	U-Theil	Confidence Index
Newfoundland				
NBER leading index	0.638	0.504	0.464	0.382
ARIMA(1,1,0)	0.713	0.559	0.553	0.265
Prince Edward Island				
NBER leading index	0.533	0.420	0.486	0.676
ARIMA(1,1,1)	0.594	0.478	0.686	0.382
Nova Scotia				
NBER leading index	0.605	0.474	0.324	0.500
ARIMA(3,1,2)	0.666	0.550	0.402	0.324
New Brunswick				
NBER leading index	0.731	0.601	0.486	0.441
ARIMA(2,1,2)	0.731	0.592	0.600	0.294
Québec				
NBER leading index	0.409	0.339	0.274	0.647
ARIMA(1,1,0)	0.457	0.360	0.324	0.500
Ontario				
NBER leading index	0.542	0.425	0.227	0.529
ARIMA(1,1,0)	0.654	0.485	0.304	0.265
Manitoba				
NBER leading index	0.519	0.435	0.338	0.559
ARIMA(1,1,0)	0.635	0.511	0.461	0.324
Saskatchewan				
NBER leading index	1.066	0.872	0.444	0.441
ARIMA(2,1,0)	1.296	1.024	0.643	0.412
Alberta				
NBER leading index	0.515	0.378	0.233	0.588
ARIMA(1,1,0)	0.601	0.451	0.302	0.441
British Columbia				
NBER leading index	0.474	0.406	0.326	0.559
ARIMA(1,1,0)	0.498	0.407	0.373	0.382

Chart 13
Out-of-Sample Forecasting Performance of the Leading Indicator Models
(Per cent)



5. CONCLUSION

Early detection of business cycle turning points is always a major concern of policymakers, business and investors, notably today because of the uncertainty with regard to the state of the U.S. economy. Economists throughout the world have built leading economic indexes to help warn in advance of cyclical changes in the economy. But their development over the last forty years has focused mostly on national indexes. Leading economic indexes for sub-national or regional economies have gained in popularity since the late 1980s with the introduction of leading economic indexes for few U.S. states. For Canadian provinces, however, no leading economic indexes are available.

The paper introduced leading economic indexes for Canadian provinces that were built with the traditional NBER methodology. They will permit to better monitor short-term business cycle developments. The empirical evaluation of their performance in forecasting cyclical turning points and growth in provincial economic activity revealed that they have useful properties. First, for all provinces, the cyclical turning points in the leading economic index lead the cyclical turning points in the coincident economic index. On average, the lead at cyclical peak is 2.8 quarters and 0.2 quarters at cyclical trough. Second, for all provinces, except Newfoundland and Prince Edward Island, the leading economic index signaled in advance all recessions in the last two decades. An important weakness, however, is the large number of false signals of a recession, three on average in the last twenty years. Third, for all provinces, out-of-sample simulation from the first quarter of 1992 showed that a leading indicator model, with only growth in the leading economic index lagged one-quarter as the exogenous variable, performs significantly better in forecasting growth in the coincident economic index than ARIMA models.

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APPENDIX A

Chart A.1
Inferred Probabilities from Markov-Switching Models
(Per cent)

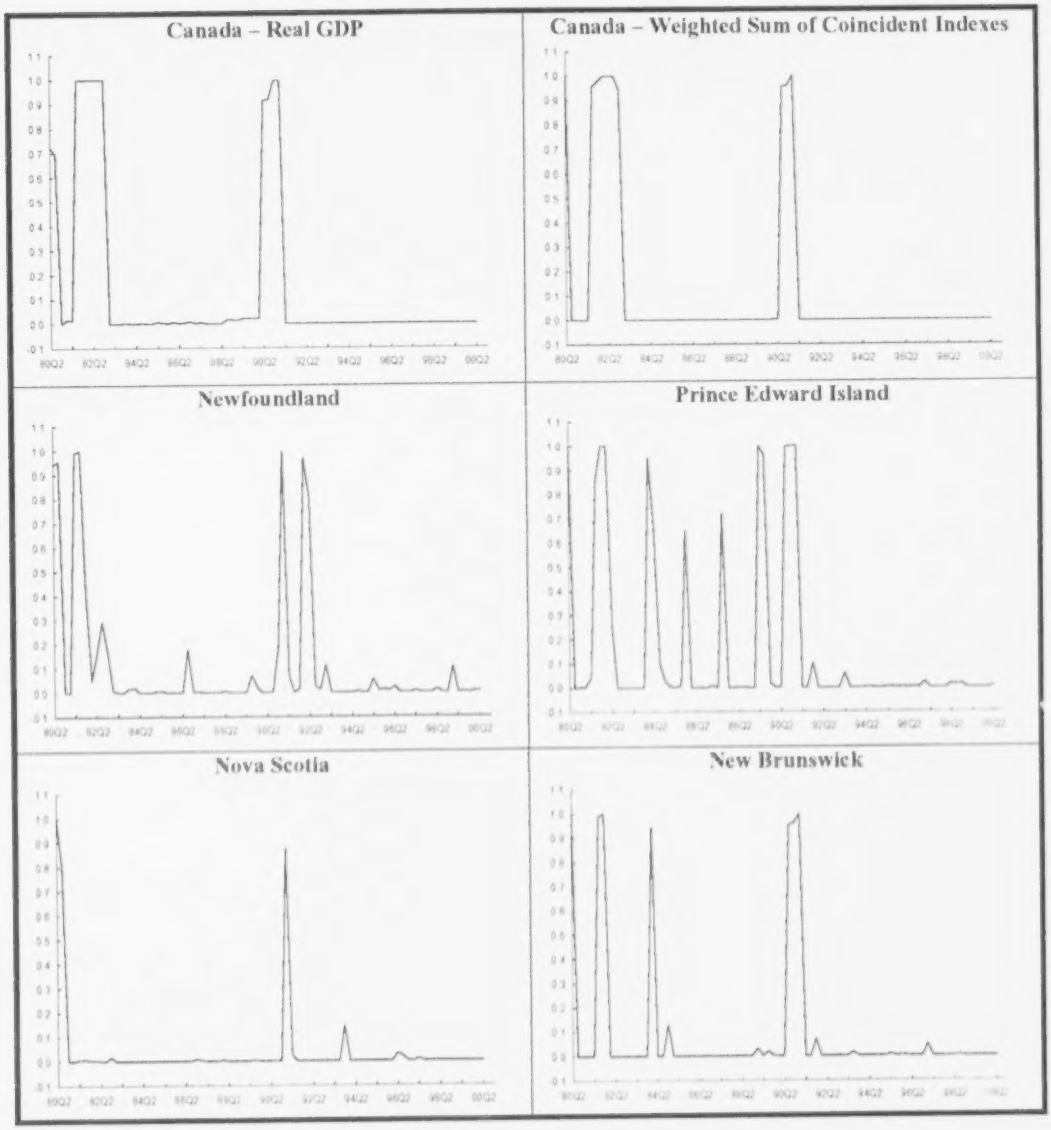
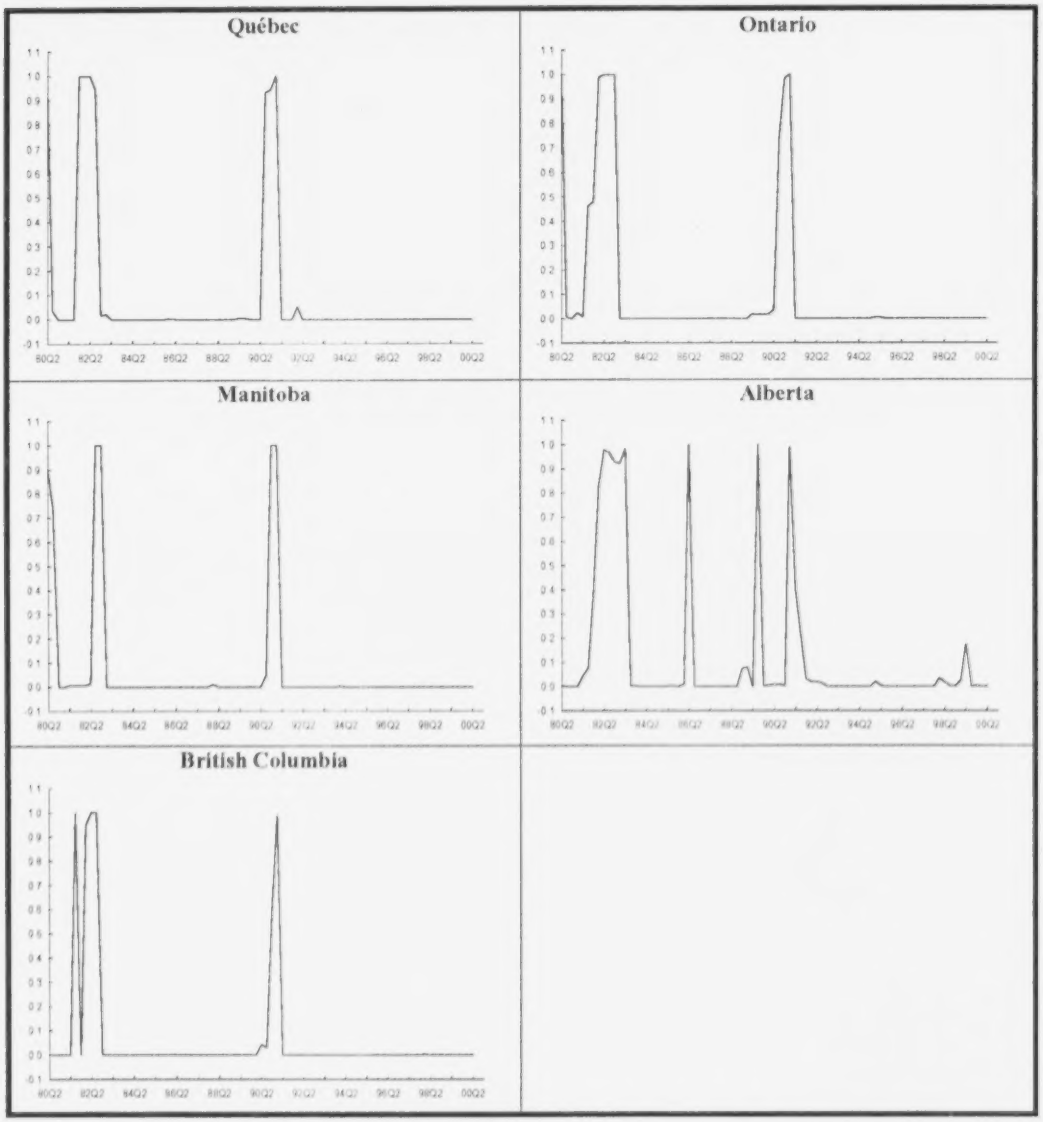


Chart A.1
Inferred Probabilities from Markov-Switching Models
(Per cent)



APPENDIX B

CONSTRUCTION OF THE LEADING ECONOMIC INDEXES: ALGEBRAIC DESCRIPTION OF THE NBER METHODOLOGY

The NBER methodology in constructing a leading economic index requires several algebraic operations on both the individual components and the index. It is done in three main stages, which are:

1. Standardisation and weighting of the components;
2. Standardisation and cumulation of the composite values;
3. Calculation of the trend-adjust index.

The following illustrates algebraically how the leading economic index for a given province was created.

1. Standardisation and weighting of selected individual components

The first step is to calculate the month-to-month symmetrical percentage changes for each component *i* of the index that are in level form. The formula is:

$$[1.1] \quad \dot{Y}_{i,t} = 200*(X_{i,t} - X_{i,t-1})/(X_{i,t} + X_{i,t-1})$$

where X_i *is* component *i*. For the components that contain zero or negatives values and for the components *i* that are already in percentage form or in ratio form, the formula is:

$$[1.2] \quad \Delta Y_{i,t} = 200*(X_{i,t} - X_{i,t-1})$$

The next algebraic operation is the standardization of the components transformed in [1.1] or [1.2]. The objective of this operation is to prevent a volatile component to dominate the change in the index. Each component, that was transformed with formula [1.1] or [1.2], was standardised by dividing it by their historical average without regard to sign. The formula is:

$$[1.3] \quad S_{i,t} = \dot{Y}_{i,t} \; / \; \Sigma \left| \dot{Y}_{i,t} \right| / (n-1) \qquad or$$

$$S_{i,t} = \Delta Y_{i,t} \; / \; \Sigma \left| \Delta Y_{i,t} \right| / (n-1)$$

The third algebraic operation combines each S_i into a composite variable. One way to aggregate the components S_i is to assume equal weights. However, a number of other methods are available to determine the weighting scheme that reflects better the relationship and the importance of each component with the reference cycle. For example, the U.S. Department of Commerce has used the following methodology. They used a scoring system to estimate the weight of a selected component. The weight is derived qualitatively from a scoring system based on seven economic and statistical criteria:

economic significance, statistical adequacy, cyclical timing, conformity, smoothness, timeliness and revisions. A quantitative method was used by Lamy (1992) in the construction of a leading economic index for the Canadian economy. Based on bivariate regressions of the standardised percentage changes of the coincident index on each standardised component, the author chose the estimated coefficient that was the most statistically significant at lag k as a weight.[10] In this project, we followed the same method for all provinces. But it is important to note that for this project, and starting in the first quarter of 1992, all weights are estimated with only past information. The weighted average of the components S^j is then computed using the equation below

$$[1.4] \qquad I_t = \sum_{i=1}^{n} w_{i,t} * S_{i,t}$$

where I_t is the raw composite value, w_i the individual weight and n is the number of indicators. Note that the weights were normalized to sum to one before applying the formula [1.4].

2. Standardisation and cumulation of the composite values

This step is to transform the raw composite value I_t so it has the same historical average (without regard to the sign) as the reference series. The standardised composite values is obtained as follows:

$$[1.5] \qquad I_t = I_t \; / \; \{ [\sum_t |I_t| / (n-1)] / [\sum_t |R_t| / (n-1)] \}$$

where I_t is the standardised composite value. The variable R_t is the symmetrical percentage change of the coincident index. Them the standardised composite value I_t is transformed into an index form using the formula below

$$[1.6] \qquad CI_t = I_{t-1} * (200 + I_t) / (200 - I_t)$$

where CI_t is the index for the province and territory j. The indexes CI_t are transformed in the next step so they have the same long-term trend as the reference series.

3 Trend-adjustment of the leading economic index

The purpose of this last stage in the construction process is to facilitate the visual comparison of the leading index with the coincident index. The objective of the trend-adjustment is to make the leading index equal to the trend of the coincident index. This is done by subtracting the long-term trend in the leading index and added in the long-term trend of the coincident index.

[10] The bivariate regressions were estimated with a correction for serial correlation.

APPENDIX C

Table C.1
Newfoundland's Leading Economic Index

Business Cycle Chronology	Lead (-) or lag (+) in signaling the cyclical turning point
	NBER index
P: 80: Q1	-2.0
T: 80: Q3	-1.0
P: 81: Q1	-1.0
T: 81: Q3	+3.0
P: 91: Q4	NS
T: 92: Q2	NS
Average lead/lag	
Cyclical peaks	-1.5
Cyclical troughs	+1.0
# of warning signals	2
# of false signals	3

P: Cyclical peak; T: Cyclical trough; NS: No signal

Table C.2
Prince Edward Island's Leading Economic Index

Business Cycle Chronology	Lead (+) or lag (-) in signaling the cyclical turning point
	NBER index
P: 81: Q2	-2
T: 82: Q1	0
P: 83: Q3	NS
T: 84: Q2	NS
P: 89: Q1	-3
T: 89: Q3	+6
P: 90: Q2	NS
T: 91: Q1	NS
Average lead/lag	
Cyclical peaks	-2.5
Cyclical troughs	+3.0
# of warning signals	2
# of false signals	2

P: Cyclical peak; T: Cyclical trough; NS: No signal

Table C.3
Nova Scotia's Leading Economic Index

Business Cycle Chronology	Lead (+) or lag (-) in signaling the cyclical turning point
	NBER index
P: 80: Q1	-2
T: 80: Q3	-1
Average lead/lag	
Cyclical peaks	-2
Cyclical troughs	-1
# of warning signals	1
# of false signals	4

P: Cyclical peak; T: Cyclical trough; NS: No signal

Table C.4
New Brunswick's Leading Economic Index

Business Cycle Chronology	Lead (+) or lag (-) in signaling the cyclical turning point
	NBER index
P: 81: Q2	-2
T: 81: Q4	+2
P: 90: Q2	-5
T: 91: Q1	0
Average lead/lag	
Cyclical peaks	-3.5
Cyclical troughs	+1
# of warning signals	2
# of false signals	4

P: Cyclical peak; T: Cyclical trough; NS: No signal

Table C.5
Québec's Leading Economic Index

Business Cycle Chronology	Lead (-) or lag (+) in signaling cyclical turning points
	NBER index
P: 81: Q3	-2
T: 82: Q3	-1
P: 90: Q2	-4
T: 91: Q1	0
Average lead/lag	
Cyclical peaks	-3.5
Cyclical troughs	-0.5
# of warning signals	2
# of false signals	2

P: Cyclical peak; T: Cyclical trough; NS: No signal

Table C.6
Ontario's Leading Economic Index

Business Cycle Chronology	Lead (-) or lag (+) in signaling cyclical turning points
	NBER index
P: 81: Q4	-3
T: 82: Q4	-1
P: 90: Q2	-5
T: 91: Q1	0
Average lead/lag	
Cyclical peaks	-4
Cyclical troughs	-0.5
# of warning signals	2
# of false signals	3

P: Cyclical peak; T: Cyclical trough; NS: No signal

Table C.7
Manitoba's Leading Economic Index

Business Cycle Chronology	Lead (-) or lag (+) in signaling cyclical turning points
	NBER index
P: 80: Q1	-3
T: 80: Q3	-1
P: 82: Q2	-4
T: 82: Q4	-2
P: 90: Q3	-3
T: 91: Q1	0
Average lead/lag	
Cyclical peaks	-3.3
Cyclical troughs	-1
# of warning signals	3
# of false signals	3

P: Cyclical peak; T: Cyclical trough; NS: No signal

Table C.8
Alberta's Leading Economic Index

Business Cycle Chronology	Lead (-) or lag (+) in signaling in cyclical turning points
	NBER index
P: 81: Q4	-2
T: 83: Q2	-3
Average lead/lag	
Cyclical peaks	-2
Cyclical troughs	-3
# of warning signals	1
# of false signals	4

P: Cyclical peak; T: Cyclical trough; NS: No signal

Table C.9
British Columbia's Leading Economic Index

Business Cycle Chronology	Lead (-) or lag (+) in signaling cyclical turning points
	NBER index
P: 81: Q4	-2
T: 82: Q3	0
P: 90: Q3	-3
T: 91: Q1	-1
Average lead/lag	
Cyclical peaks	-2.5
Cyclical troughs	-0.5
# of warning signals	2
# of false signals	4

P: Cyclical peak; T: Cyclical trough; NS: No signal

APPENDIX D

Table D.1
Weight Attached to Components of the NBER Leading Economic Indexes by Province

	Nfld.	PEI	NS	N. -B.	Québec	Ontario	Man.	Sask.	Alb.	B.C.
Forward-looking consumer attitudes index	0.106	0.115[1]	0.053	0.042	0.045	0.039	0.057	0.086	0.031	0.079
Real residential building permits, smoothed	0.067	0.142	0.067	0.215	0.147	0.141	0.141	0.114	0.129	0.206
Real non-residential building permits, smoothed	0.126	0.120	0.150	0.095[2]	0.132	0.197	0.049	0.069	0.073	0.090
Oil and gas wells permits in Alberta									0.060	
Index of commodity prices			0.085					0.078	0.073	0.052
Leading economic index for the U.S.	0.150	0.256	0.230		0.168	0.154	0.184	0.134[3]	0.083[3]	0.107
Residential building permits for the U.S.				0.179						
Oil and gas wells drilled in the U.S.								0.096	0.089	
Leading economic index for Europe	0.172									
Leading economic index for Japan							0.093			0.087
Slope of the yield curve	0.191	0.231	0.194	0.230	0.250	0.197	0.237	0.184	0.174	0.173
Help wanted index	0.186	0.135	0.220	0.239	0.258	0.271	0.240	0.238	0.289	0.207

1. Actual index.
2. Seasonally adjusted, not smoothed.
3. Form U.S. Conference Board.